PETROLEUM
REFINING
•
PETROCHEMICAL
MANUFACTURING
•
GAS LIQUID
RECOVERY

JUNE, 1957

Petroleum Processing

Oil Shale Research—King-Size . . . p. 77

How to Do a Better Job of

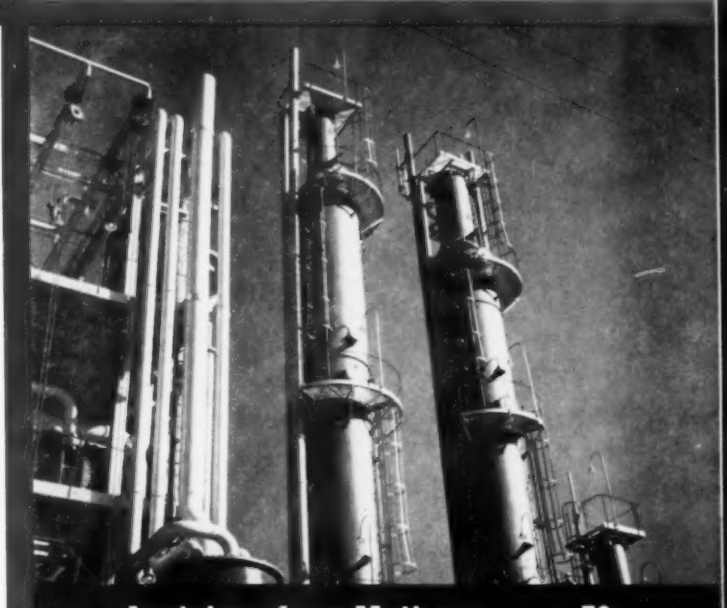
Low Temperature INSULATION

a special 16-page report

by Ron Cannon starts on p. 97

MID-YEAR OUTLOOK

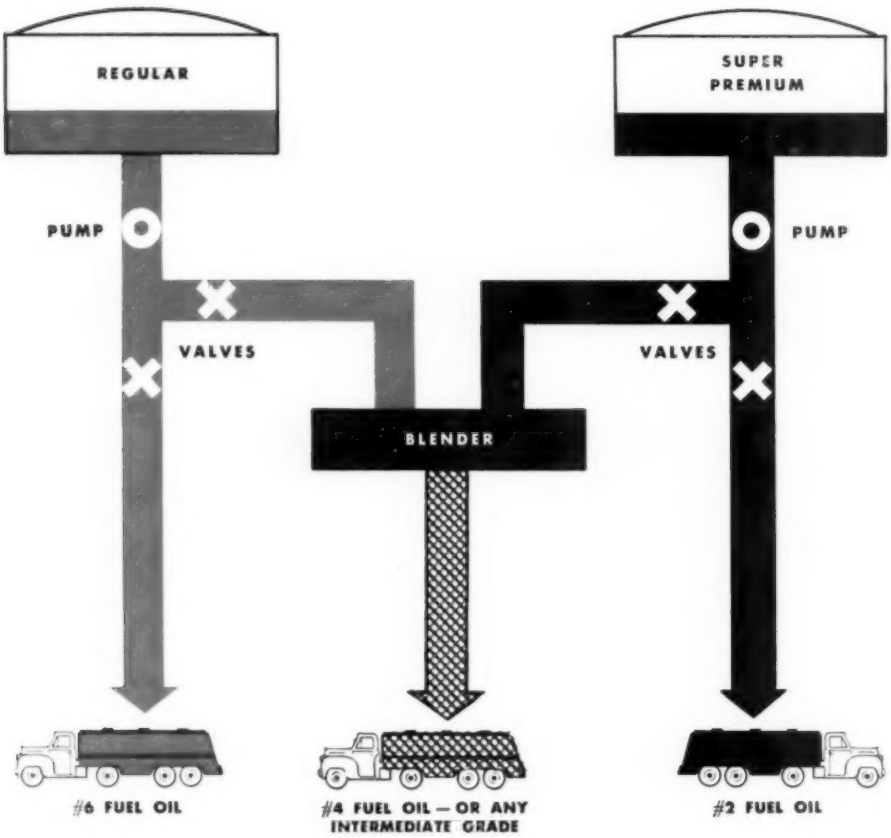
Your annual revised forecast on supply and demand for petroleum products by the Editors . . . p. 78



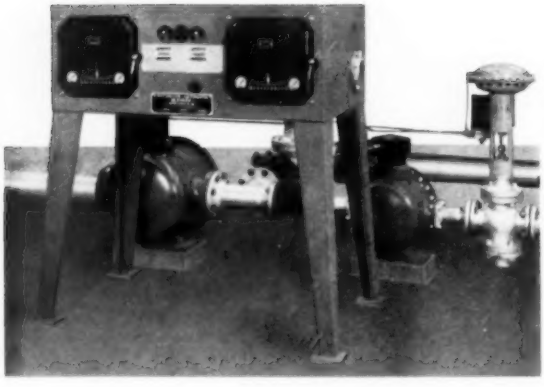
Acetylene from Methane . . . p. 70

A McGRAW-HILL PUBLICATION

PRICE ONE DOLLAR



stock TWO, sell THREE!



Are you committed to two premium motor fuels? Capitalize on current market demands for higher octanes to augment present regular and premium grades. Offer these super premium grades *without costly additional tankage!*

How? Store only regular and super premium grades at your terminal . . . install a Proportioneers TC Blender (available immediately) . . . and be able to supply these and any intermediate grade simultaneously. The TC Blender provides accurate, flexible in-line blending directly from component storage to tank truck, tank car, or barge.

Whatever the market octane demand, make your operation flexible enough to meet it!

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DIVISION OF
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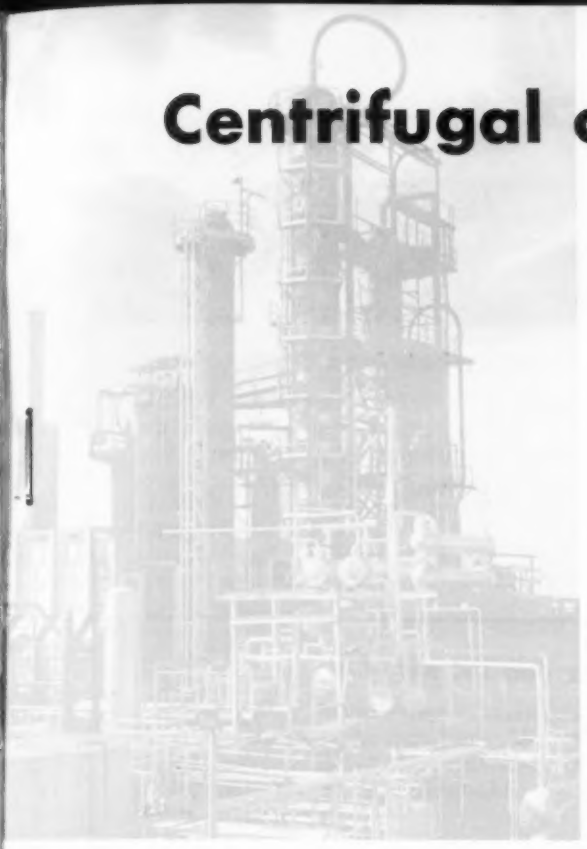
Centrifugal or Reciprocating?



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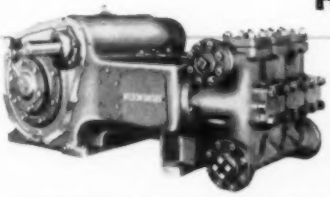
...and KNOW you are getting the type of pump that is BEST for your refinery applications

SINCE 1878, the Wilson-Snyder trade name has been synonymous with the highest quality in heavy-duty pumps. Their performance records in thousands of refinery installations throughout the United States and in foreign countries have established them as the industry's finest pumps.

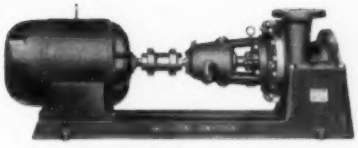
While centrifugal pumps are widely used for process work, there are specific applications for which reciprocating pumps offer definite advantages from the standpoint of both performance and economy.

As a manufacturer of both centrifugal and reciprocating types (including both power-driven and direct-acting steam-driven), you can be sure our unbiased recommendation will be the type best suited for your specific applications.

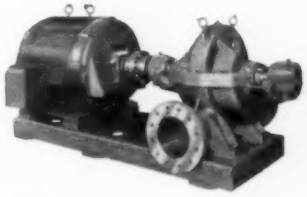
Here are Four Popular Types



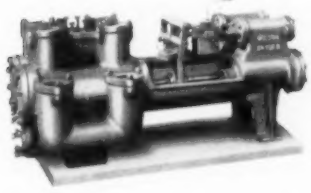
TRIPLEX PLUNGER-TYPE POWER PUMPS . . . Designed for handling a wide range of products, including highly volatile liquids over a wide temperature range, and time-proven in high-pressure charge pump service. Available in 4", 6" and 8" stroke sizes for capacity requirements up to 500 GPM and pressures up to 5,650 psi.



ES CENTRIFUGAL PROCESS PUMPS . . . Single or two-stage heavy-duty type for elevated temperature applications to 900°F., employing vertically split case and single stuffing box for conventional packing or mechanical seal of your choice. End suction, as illustrated, is standard construction—can also be furnished with top suction when preferred. Twenty sizes provide capacities from 15 to 2,000 GPM, 50 to 1100-ft. head, 2 to 250 HP.



DOUBLE SUCTION CENTRIFUGAL PUMPS . . . Single-stage heavy-duty type for temperature applications to 300°F., employing horizontally split case with impeller mounted between bearings. Side suction and side discharge arrangement is standard—bottom suction arrangement is available in 14" and larger sizes. Fourteen sizes provide capacities from 100 to 30,000 GPM, 20 to 300-ft. head, 5 to 1,500 HP.



DUPLEX PISTON-TYPE DIRECT-ACTING STEAM PUMPS . . . Designed for handling a wide range of products for all general service requirements, including the handling of volatile liquids over a wide temperature and pressure range. Available in stroke lengths from 6" to 24" for capacity requirements to 1800 GPM and pressures to 800 psi.

Our long experience qualifies us to design and build pumps to satisfy your most exacting requirements. Ask for catalog containing complete WILSON-SNYDER PUMP *specifications and let us quote on your requirements.*

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UNITED STATES STEEL

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What's New in Petroleum

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Special 16-page

PETROLEUM PROCESSING Report

How to do a better job of

LOW TEMPERATURE INSULATION

By Ron Cannon. Starts on **p. 97**

- What is meant by low temperature, the mechanics of vapor pressure, the problems to be solved.
- Types of insulation for low temperatures, their important properties, the qualities to look for in insulation, and in materials for vapor barriers.
- Special problems: how to solve them and how to obtain a profitable, practical, and efficient installation.
- Systems: how to apply a complete low temperature insulation system on process equipment.
- Maintenance: how to achieve long service life.

I II III 2 3 4

The asphalt debate is on

Oil company and highway department officials from all over the country tell what goals the asphalt industry must reach if it is to earn its fair share of the coming highway program expenditures. A PETROLEUM PROCESSING Clinic-in-Print. **p. 65**

I 2 3 5

Sulfur and 100 octanes

How important is sulfur in today's high quality gasolines? What techniques and processes can you use to reduce the problem? See "What Sulfur Means to 100 Octane Fuels" by G. H. Unzelman. **p. 70**

I III 3 5

Shale oil research—king size

New multi-million dollar shale retorting pilot plant now in operation in Colorado by Union Oil Co. of California can be key to new sources for petroleum products—both the conventional materials and the petrochemicals. **p. 77**

I II 1 2 3 5

Forecast revised at mid-year

The supply-demand outlook today for the rest of 1957, as seen by V. B. Guthrie. Your annual mid-year revised forecast shows significant post-Suez changes with the resultant shifts in product movements. **p. 78**

I 3 5

PETROLEUM PROCESSING
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June, 1957
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Processing for June, 1957

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Tomorrow's instrument repairman

What will he be like? What training will he have to have? What will his job consist of? Here are the results of a brand-new survey to find the answers to 24 meaningful questions about the instrument maintenance man of 1962 and 1967. By C. H. Trotter and A. P. Olbrich of Phillips Petroleum Co. **p. 80**

And this month's M&C problem corner answers this question: How can you reduce the problem of leaks from mechanical seals in equipment in propane service. **p. 83**

I II III 3 4

Technical tips for you

Today's up-to-the-minute data from operating men and engineers. The fifth in our 1957 series of articles from the popular question-and-answer session of the WPRA fall meeting. See "Catalytic Reforming Problems." **p. 84**

I III 3

Acetylene from methane

The technical details describing how acetylene is made by the partial combustion process, plus some significant figures on why it is booming today in the field of chemical synthesis. By Peter W. Sherwood. **p. 88**

II 1 2 3

Is your data file complete?

Are you using the "Clip-n-File" departments to full advantage? This month's Process Data Sheet, No. 19, **p. 119,** covers the Powerforming process, and the Engineering Data Sheet, No. 18, **p. 131,** gives data on instrument terminology.

I II III 1 2 3 4 5

Coming next month

"Tidewater—Delaware"—the first complete technical story of this brand new East Coast refinery, largest ever built from the ground up. Over 60 pages of articles on every phase of operation.

I II III 1 2 3 4 5

DEPARTMENTS

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SUBSCRIPTIONS are solicited only from executives, supervisors, engineers, and other technical personnel engaged in petroleum and petrochemical research and development, and in the design and engineering, operation, maintenance and construction of petroleum refining, petrochemical processing and gas-liquids-recovery plants. **Position and company connection must be indicated on subscription orders.**

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Continue "Reader's Guide" on p. 115.

HOW TO USE IT:

Your new "Reader's Guide to What's New in PETROLEUM PROCESSING" will do two things for you. First, the key numbers with each article will tell you at a glance if it is within your scope of interest: roman numerals indicate industries; arabic numerals show fields of activity. Secondly, the longer descriptions will tell you what each article is about, and why it can be of help and interest to you—THE EDITORS

Ethyl research takes a new approach to match future fuels and engines

By H. J. Gibson, Technical Director, Ethyl Corporation Research Laboratories

Combustion characteristics of future gasolines in tomorrow's engines have been defined in an extensive study recently completed in the Detroit Research Laboratories of Ethyl Corporation. This project pursued these two basic objectives.

First, to find out how variations in hydrocarbon composition, sensitivity and other characteristics would affect the ability of gasolines to meet the fuel requirements of tomorrow's engines.

Second, to determine how future engines could be modified to permit effective use of the widest possible range of fuel characteristics.

Engine Adjustments Lower Octane Requirement

Three high-compression test engines were selected for their high volumetric efficiencies and because each represented a different philosophy of combustion-chamber design. Compression ratios were increased to 11-to-1, a ratio that can be expected in passenger car engines in the near future.

Each engine was completely calibrated on an engine dynamometer in order to assure realistic tailoring of the carburetion and ignition characteristics of the engine for the most effective use of commercial-type gasolines.

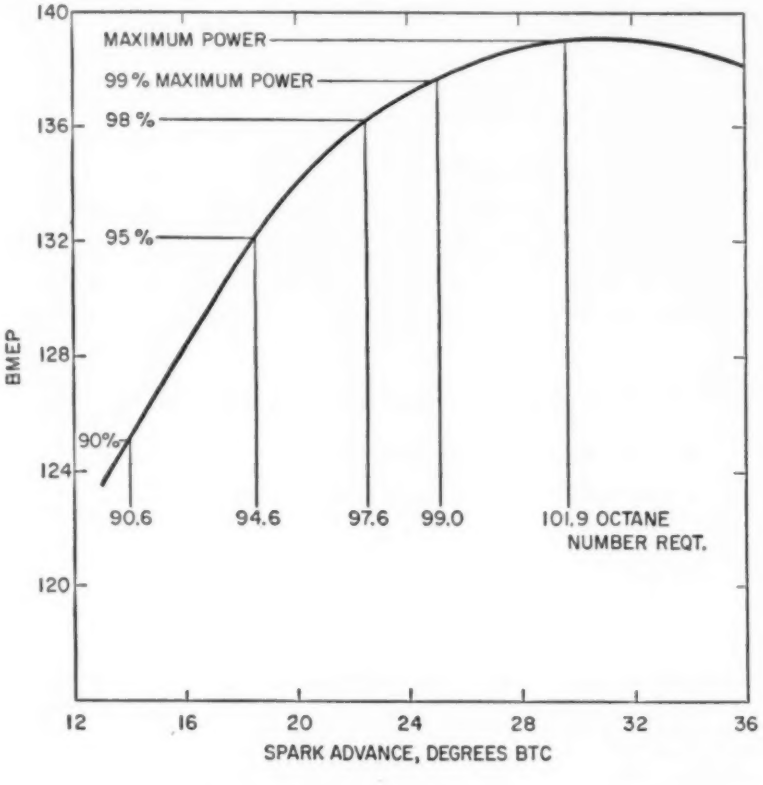
The engines were then installed in automobiles for road ratings of the fuels under test. Over one hundred commercial-type gasolines, including a wide variety of hydrocarbon compositions, were rated in these vehicles under carefully controlled conditions on a chassis dynamometer.

Results of the investigation indicate that a number of compromises can be made between engine performance and engine-fuel requirements.

For example, it was possible to lower the octane requirement with only nominal power loss and without significantly affecting fuel economy, by adopting slight modifications of spark advance and carburetor design.

It was further shown that it will be desirable for refiners to maximize the paraffinic and aromatic contents of their fuels in order to attain satisfactory operation at high engine speeds.

Low-cost olefinic blending components will continue to be effective in meeting the Research-octane-number specification required to satisfy the engine at low speeds.



This graph illustrates the relation between ignition timing and engine output for one engine at one speed. With ignition timing set for maximum power, the antiknock requirement is 101.9 octane number. When ignition timing is retarded to 99 per cent of maximum power, the octane requirement is reduced to 99. Thus, engine requirement can be reduced 2.9 octane numbers by sacrificing only one per cent in power.

(To obtain more data on advertised products see page 158)

Equation Predicts Road Octane Number

Using a digital computer, Ethyl statisticians analyzed the vast amount of data obtained from the tests. Extensive correlation equations were developed to aid refiners in blending their gasolines to the actual road antiknock requirements of current and future cars.

The best linear relation existing between road octane number and fuel-inspection data, such as Research and Motor octane numbers and hydrocarbon composition, was determined for each car.

Analysis of these equations showed Research and Motor octane numbers do a good job of defining road gasoline performance at low engine speeds.

At high speeds, however, consideration of gasoline composition, in addition to Research and Motor octane numbers, is useful in predicting gasoline antiknock performance. The correlation equations took the following form:

ROAD OCTANE NUMBER = A
+B *(Research Octane Number)*
±C *(Motor Octane Number)*
+D *(% Olefins)*

where A, B, C, and D are constants determined by analysis.

Additional properties, such as the volatility of the gasoline, do not materially enhance the degree of correlation.

Ethyl studies of the potential of future fuels and engines continue. The results will be distributed to oil companies. The data also will be discussed with automotive companies to acquaint them with the probable composition of future fuels as they may affect future engine design.

We believe such efforts will help to preserve a reasonable relationship between the advantages of high compression engines and their octane requirements.

In Ethyl's extensive road-rating program a digital computer was used to provide maximum statistical interpretation of the test data.

How Ethyl Research Is Helping You

Because of Ethyl's interest in the mutual problems of the petroleum refiner and automobile manufacturer, the extensive research program briefly described here was initiated to define the antiknock performance of future gasolines in tomorrow's engines.

This progress report is one more example of how Ethyl Research—outstanding in the study of engine-fuel relationships—continues to be of service to the petroleum industry.

Copies of the detailed report, "Matching Gasoline Antiknock Performance and Future Engines," presented at the May, 1957 meeting of the API Refining Division at Philadelphia, may be obtained from your Ethyl representative.

ETHYL CORPORATION
New York 17, N. Y.

ETHYL ANTIKNOCK COMPOUND — ETHYL CORPORATION

RESEARCH LABORATORIES:
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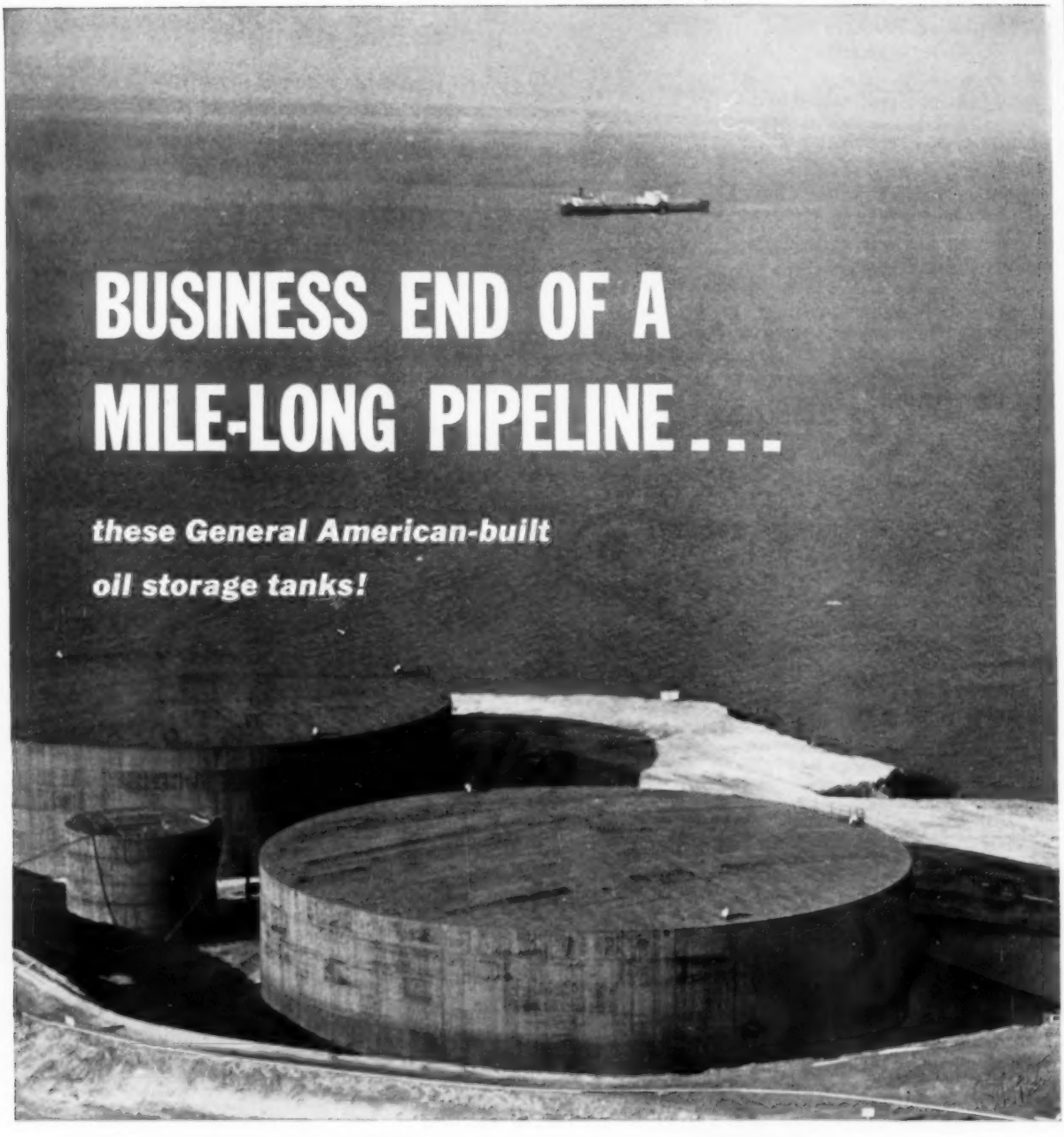

Moored more than a mile offshore in 70 feet of water, even the world's largest tankers (or any tanker presently contemplated) can deliver cargoes direct to these twin 268,000-barrel storage tanks . . . eliminate double handling and costly barging charges.

Each 200 feet in diameter, 48 feet in height, the tanks were custom-engineered, erected on the site by General American's Plate and Welding Division for Northville Dock's new Long Island Terminal. New York State's largest tanks . . . they provide storage for 22,500,000 gallons of oil.

If you need expanded storage right now, or as insurance against future demands, look into the facilities offered by General American. Whatever your storage problem—liquid or gaseous—you'll find . . . *it pays to plan with General American.*

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Platt's Oilgram Price Service

Dear Reader...

... The certificate reproduced below has just been added to the collection of "trophies" hanging in our editorial offices.

This one came as a result of the special report on "Hydrogen Processing" we published in our November, 1956, issue. We thought highly enough of the report to enter it in **Industrial Marketing's** 19th Annual Editorial Competition for Business Publications. The judges decided it was good, too, and this month awarded it a certificate for "outstanding original research."

Actually, the report doesn't represent "original research" of the type you in the petroleum processing industries are familiar with. What it does represent is a whale of a lot of literature searching and original field interviewing to pull together all the facts that went into it.

Bob Davidson, our Associate Editor and the man responsible for this report, did a monumental job of research. In addition to reading what little he could find in textbooks on the subject, he studied over 100 technical articles and more than 300 patents. He talked to refiners, licensors, and engineering contractors. He also corresponded with at least 30 other firms for more general information. And, lastly, he sent questionnaires to all U.S. and Canadian refiners and major natural gasoline companies.

We're not really surprised that Bob's work won an award, however. If you knew him as well as we do, you'd know that anything he tackles is done thoroughly—with an attention to detail that would make any real researcher envious.

Bob's been with us nearly three years. He came to our staff with a background rich in experience useful to his present job, having had such posts as process engineer with Aramco and with Du Pont at its Orange, Texas, plant. He now makes his home with his wife Betty and three-year-old Roberta in New Shrewsbury, N. J., where he is active on the community planning committee.

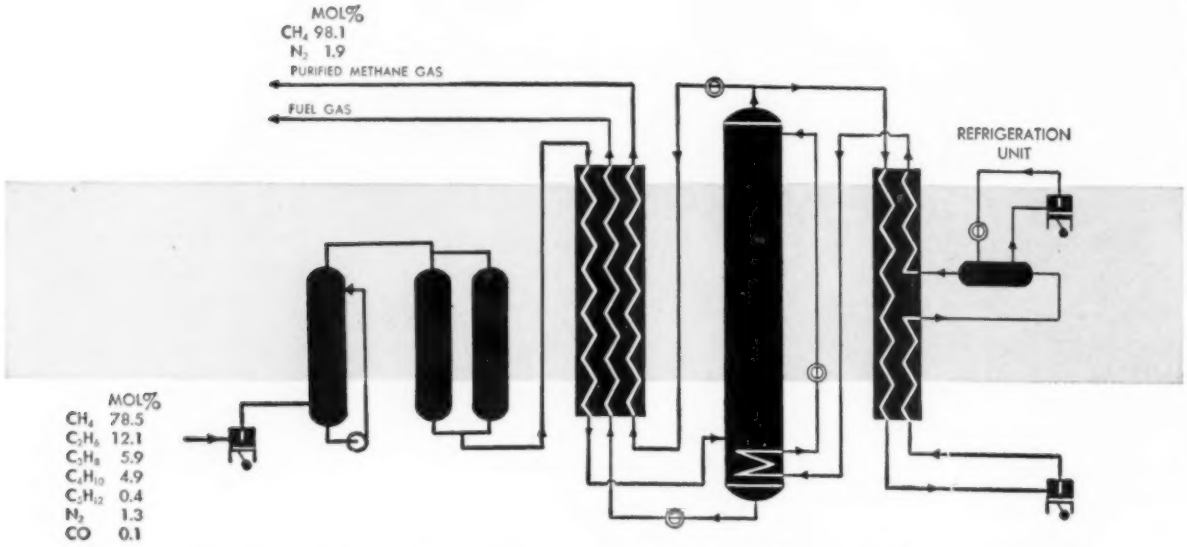
As he described it, his job with us is "the first job I've had where I really feel I am doing something." And judging from our own observations, we're very much inclined to agree.

William F. Bland

—Editor

practical approach to

METHANE PURIFICATION



Methane gas purification unit

In the production of chlorinated methane compounds and other chemicals based upon methane, the methane processed must be of ultra high purity. Air Products low-temperature processing plants—accepted as the most economical and practical approach—produce methane containing less than 100 p.p.m. of other hydrocarbons.

Air Products methane purification plants feature many cost-saving and special processing advantages:

- extremely high-purity methane, bone-dry and CO_2-free.
- valuable by-products—LPG, other heavy hydrocarbons, nitrogen.
- automatic control—requiring a minimum of labor.
- low power consumption.
- factory-assembled plants—assuring minimum installation expense.

Many chemical plants are already using Air Products low-temperature equipment. In addition to the production of ultra high-purity methane, Air Products units are being used for the production of oxygen, nitrogen, argon and hydrogen . . . as well as the processing of natural gas, carbon monoxide, deuterium, fluorine and helium.

Here at Air Products, we design, manufacture, erect and operate . . . package, tonnage and custom-built industrial gas separation, liquefaction and purification systems. No matter what your requirements, Air Products will find a way for you to acquire or lease low-temperature equipment on mutually convenient and beneficial terms. Your inquiry is invited. Air Products, Incorporated, P. O. Box 538, Allentown, Pa.

Air Products
...INCORPORATED

(To obtain more data on advertised products see page 158)

WHAT'S HAPPENING

In refining

. . . **American Petrofina** is considering expanding refining capacity of the absorbed Panhandle Oil Corp. by 10,000 b/d, and also contemplates some hike in refining capacity for the recently acquired subsidiary, American Liberty Oil Co.

. . . **British American Oil Co. Ltd.** has more expansion plans (PP, 5-57, p. 9). Refining capacity in the Canadian prairie provinces are under consideration to meet anticipated growth in products demand.

. . . **Canadian Petrofina** will boost capacity at the Pointe-aux-Trembles refinery near Montreal, Quebec, to 30,000 b/d from its present 20,000 b/d "as soon as possible."

. . . **Champlin Oil & Refining Co.** will build a 1400 b/d, Phillips-licensed, hydrofluoric acid process alkylation unit at its Enid, Oklahoma, refinery. Badger Manufacturing Co. will build the plant, with completion expected by March, 1958.

. . . **Chemoil Corp.** plans a 30,000 b/d refinery between Baton Rouge and New Orleans, La. Construction is planned to start within a year. Units in the refinery will include cat cracking, reforming, alkylation, polymerization, coking and treating.

. . . **Cities Service Co.** is ready to begin research on the effect of nuclear radiation (Cobalt-60 source) on petroleum processing at its new Cranbury, N. J., laboratory. (See photos p. 129)

. . . **Esso Research & Engineering Co.'s** nuclear energy research has "actually produced gasoline from heavier oil stocks and from refinery gases, although still in very small-scale laboratory tests." Tests were made in the swimming pool reactor at Batelle Memorial Institute center at Columbus, Ohio.

. . . **Gulf Oil Corp.** scientists have developed a new spectrographic analysis to detect trace impurities in feedstocks to platinum-containing catalysts. Arsenic can be detected in parts per billion concentrations.

. . . **Kerr-McGee Oil Industries, Inc.** has approved a $4-million expansion of its Wynnewood, Okla., refinery (PP, 4-57, p.9), to include a 7350 b/d naphtha prefractionator, 5500 b/d distillate Unifiner, 5500 b/d Platformer. C. W. Nofsinger Co. of Kansas City, Mo., is the engineer.

. . . **Richfield Oil Co.** plans a 50,000 b/d refinery on its recently acquired 1000-acre site near Everett, Wash. (PP, 2-57, p.9). The planned onstream date for the $50-million refinery will be 1965. Richfield does not plan to build until its products volume in the area reaches 36,000 b/d. At present the volume is 25,000 b/d and increasing about 5% per year.

. . . **Shamrock Oil & Gas Corp.** plans to build two Phillips-licensed units at Shamrock's Sunray, Texas, refinery. A 2000 b/d aluminum chloride catalyst isomerization unit will convert normal butane into isobutane. The isobutane then goes to a Phillips thermal cracker to produce mixed isobutane and butylene for alkylation feedstock.

. . . **Shell Oil Co.'s** planned Platformer for its Norco, La., refinery (PP, 5-57, p.9) will have a capacity of 12,000 b/d.

. . . **Standard Oil Co. (Ohio)** has licensed its Boron additive for use by Richfield Oil Corp. and D-X Sunray Oil Co. in their own premium gasolines.

. . . **Supertest Petroleum Corp. Ltd. of Canada** has dropped plans to build a refinery because of Canadian government restrictions on capital use.

. . . **The Texas Co.** plans to shutdown its 8000 b/d refinery at Sunburst, Mont., in the first quarter of 1959 when Texaco's Puget Sound Works, Anacortes, Wash., will start operations.

. . . **Other new construction projects,** indicated by recent fast tax write-off approvals, are:

- Southland Oil Co., Tampa, Fla., $8.2-million for a proposed 15,000 b/d refinery.
- Phillips Petroleum Co., Andrews County, Texas, $656,000 for a natural gas liquids gathering system.
- Sunshine State Refineries, Tampa, Fla., $675,-

The demand, stocks, trends picture

	1957 to May 24	1956 All May	% Change
Runs to Still	7.981	7.865	+1.5
Demand			
Gasoline	4.128	3.991	+3.4
Middle dist.	1.400	1.445	—3.1
Residual	1.459	1.532	—4.8
Stocks			
Gasoline	194.373	184.676	+5.2
Middle dist.	115.467	98.341	+17.4
Residual	39.791	35.686	+11.5

(Figures are in million b/d, API data)

For more details, turn to p. 153, this issue

000 for a 500 b/d alkylation unit at a proposed 10,000 b/d refinery.

In gas liquids recovery

. . . **Sinclair Oil & Gas Co.** will install a 1100-hp compressor at its gas products plant near Taft, Texas, to boost residue gas pressure from 160 to 1000 psig.

. . . **Gulf Oil Corp.** plans a new plant to upgrade low-octane natural gasoline at its Port Arthur, Texas, refinery.

In petrochemicals

. . . **B. F. Goodrich Co.** is fighting the U.S. government's claim to the synthetic "natural" rubber process developed by Goodrich-Gulf Chemicals, Inc. The government contends that "Ameripol SN rubber" was developed under government auspices. Goodrich counters that the discovery was based on scientific knowledge purchased by Goodrich-Gulf in Europe in 1954.

. . . **California Oil Co.** will have a sulfur recovery plant adjacent to its Perth Amboy, N.J., refinery. To be completed by the end of the year, the plant will be built and operated by Anlin Co., with Caloil supplying 7-million cu ft/day gas to the plant.

. . . **Chemstrand Corp.** will boost Acrilan acrylic fiber production at its Decatur, Ala., plant from 30-million to 45-million lb/yr. New facilities should be ready by early '58. Another project will increase the capacity of its Pensacola, Fla., nylon plant from 59-million to 114 million lb/yr by mid '58.

. . . **Dow Chemical Co.** will build a petrochemicals plant, consisting of a cracking unit, ethylene unit and butadiene unit, at Bay City, Mich. (adjacent to Bay Refining Corp. acquired by Dow last summer).

. . . **Magnolia Petroleum Co.** is studying feasibility of petrochemicals manufacture—either by itself or in cooperation with another firm. Any facilities built would probably be near its Beaumont, Texas, refinery.

. . . **Monsanto Chemical Co.** will increase acrylonitrile capacity to 100-million lb/yr or more at its Texas City, Texas, plant. Expansion should be completed by the end of this year.

. . . **Permian Basin Pipe Line Co.** is increasing the capacity of its Mitchell, Texas, carbon dioxide plant to 105-million cu ft/day. Cost is $3-million, and adds 80-million cu ft/day to present capacity. Dresser Engineering Co., contractor for the expansion, has another contract to add an additional 40-million cu ft/day of capacity by early-58.

. . . **Shell Oil Co. and Devon-Palmer Oils Ltd.** are backers of a 300 t/d sulfur recovery plant to be built in Okotoks, Alberta, Gas Field District. Completion is due in 1958, with Devon-Palmer operating the field installations and plant.

. . . **Spencer Chemical Co.** will double the polyethylene capacity of its Orange, Texas, plant. The new capacity will be 90-million lb/yr.

. . . **Surpass Petrochemicals Ltd.** (Montreal, Quebec,) is building a $1-million, 7-million lb/yr, petroleum sulfonates plant near Scarborough, Ontario. The new plant, first of its kind in Canada, will also make lithium-based greases and synthetic lubes.

In foreign operations

. . . **Europe**

. . . **ANIC of Milan, Italy,** a member of E.N.I. (Ente Nazionale Idrocarburi), plans to increase the capacity of its not yet completed synthetic rubber plant in Ravenna, Italy, by 20,000 metric tons/yr. Originally designed to make 35,000 metric tons of GR-S rubber per year (using the Union Carbide process to make butadiene from methane and the Phillips Petroleum co-polymerization process), the additional capacity will use butadiene from butane and a Koppers Co. styrene process.

. . . **British Petroleum Co. Ltd.** plans to boost capacity of its Grangemouth, Scotland, refinery by about 20,000 b/d, bringing plant capacity up to about 62,000 b/d by 1959. Cost will be $11-million.

. . . **Esso A. G.** plans a new refinery in Wesseling at the end of a proposed pipeline from Wilhelmshaven. Initial operations will be in late '58 or early '59 with a capacity of 68,000 b/d, increasing to 116,000 b/d in 1965.

. . . **Esso Petroleum Co. Ltd.** has awarded a construction contract to Foster Wheeler Ltd. for Esso's $25-million ethylene-propylene-butylene-butadiene plant at Fawley, England.

. . . **Gottlieb Duttweiler,** Swiss oil marketer says that a U.S. oil company will join him in building a $15-million, 30,000 b/d refinery at Emden, West Germany. Completion is planned in two years.

. . . **Halvic Co.** of Austria, formed by the Vienna nationalized banking institute Creditanstalt-Bankverein, Swiss Solvay & Co., and British Imperial

This 150-Foot Hose
STRETCHES AROUND THE WORLD

Refueling-in-air techniques such as these now make possible non-stop trips around the world. But no matter where the refueling takes place, the pipeline begins at the nation's refineries.

With experts predicting that by 1965 refined product sales will have increased 2½ times over 1946, the need for efficient refinery operations is obvious. Perhaps Polyrad—the filming amine inhibitor and detergent—can play a role in your operation.

Polyrad forms a molecular film that protects metal from attack and reduces down time caused by corrosive damage. Polyrad's detergent action keeps metal surfaces clean to maintain heat transfer and operation at unit capacity.

A Hercules trained representative will be glad to tell you how Polyrad can protect your refinery. Stocks are maintained at strategic points throughout the country and overseas.

Pine Chemicals Division, Naval Stores Department

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984 King St., Wilmington 99, Del.

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POLYRAD®

FILMING AMINE INHIBITOR

NA57-2

(To obtain more data on advertised products see page 158)

Chemical Industries, expects polyvinyl chloride production to increase from 2000 metric ton/yr in 1957 to 8000 metric ton/yr in 1958.

. . . **An Irish company** is being formed by California Texas Oil Co., Esso Petroleum, Shell-Mex and British Petroleum to build and operate a 40,000 b/d, $30-million refinery in Eire. Completion is due 1959.

. . . **Manchester Oil Refinery** (Holdings) Ltd. has a new sulfonate plant in trial operation at Manchester, England.

. . . **Montecatini** will be in "commercial" polypropylene production soon.

. . . **Oesterreichische Stickstoff Werke** (Linz, Austria) and I. G. Farben (Hoechst, West Germany) are negotiating to set up a petrochemicals plant in Austria near a refinery of Oesterreichische Mineraloel Verwaltung, using ethylene gas from the refinery.

. . . **Vereinigte Chemische Fabriken** of Austria will increase formaldehyde capacity from 5000 metric ton/yr to 13,000 metric ton/yr by this fall.

. . . **The East**

. . . **Firestone Tyre & Rubber Co. of India, Ltd.** will enter into a partnership with the National Industrial Development Corp. to build a 20,000 ton/yr synthetic rubber plant near Bombay.

. . . **Goodrich Chemical Co.** will agree to a technical tie-up with Nippon Zeon to build a synthetic rubber plant in Japan. Nippon Zeon, a vinyl chloride manufacturer, will be backed by the Yokohama Rubber Co., a tire manufacturer, and other companies of the Furukawa gronup (of which Nippon Zeon is a member). Initial production will be 8500 ton/yr of rubber.

. . . **Assam Oil Co.,** subsidiary of Burmah Oil Ltd., has reached a "general agreement" with the Indian government to form two new companies to produce and refine oil in northeastern India—probably in the West Bengal province.

. . . **Latin America**

. . . **Panama Refining & Petrochemical Co., Inc.** has awarded Foster Wheeler the contract for a $33-million, 55,000 b/d refinery in Panama's Colón Province on the Atlantic Coast. Completion is due in less than 2 years.

. . . **Brazil's National Petroleum Council** has changed the law (against protests by Brazil's oil monopoly, Petrobras) that had prohibited private refineries from increasing capacities.

In transition

. . . **Union Carbide** divisions now have new names. Union Carbide and Carbon Corp. is now Union Carbide Corp.; Carbide and Carbon Chemicals Co. is now Union Carbide Chemical Co.; and Linde Air Products Co. is now Linde Co.

. . . **Standard Oil Co. (Calif.)** has combined its two chemical subsidiaries, Oronite Chemical Co. and California-Spray Chemical Corp., into California Chemical Co. Oronite and Calspray will operate as subsidiaries of California Chemical.

. . . **Kerr-McGee Oil Industries, Inc.** has acquired capital stock of Triangle Refineries, Inc. Triangle will continue to operate under its name, but as a subsidiary of Kerr-McGee.

. . . **Southern Natural Gas Co.** may buy Suntide Refining Co. Negotiations are reportedly under way. Sale would include the 60,000 b/d refinery at Corpus Christi, Texas, two pipelines from Corpus Christi to the deep-water channel, and marketing facilities.

. . . **Oil Company mergers** may have to be preceded by a 60-day notice to government agencies if the pre-merger bill sponsored by the House Judiciary Committee is made into law.

In markets and prices

. . . **With the appearance of avgas** in the open market at the Gulf Coast, oil marketers seemed suddenly pessimistic about the prices of all products. Up until recently, avgas was considered the one product able to weather the ups and downs of routine market influences.

The softest item, many sources said, was kerosine. Normally selling higher than No. 2 fuel, some traders believed it scarcely could command a price equal to No. 2 in the open market. One refiner, saying that kerosine was "suffering from old age," was hopeful that military and civil jet fuel requirements in the next 12 to 24 months would "save the product's future."

Opinion was widespread that high refinery runs and soft markets were hurting domestic crude. Being considered by refiners was a switch from Southwest Texas crudes to West Texas intermediates.

Looking ahead

. . . **An investment in the future** is Socony Mobil Oil Co., Inc.'s support of a professorship in Nuclear Science at Princeton University. Socony provides $17,000/yr to pay the salary of the professorship and cover expenses incurred by him in research studies.

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

385 Madison Avenue New York 17, N. Y.

Lummus to Build 200,000,000 lb. per Year Ethylene Plant for Petroleum Chemicals, Inc.

Installation Designed for 50% Expansion

The Lummus Company is presently designing and will build for Petroleum Chemicals, Inc. at Lake Charles, Louisiana a plant to produce 200,000,000 pounds per year of ethylene. Scheduled for completion by the end of 1957, the plant is designed to permit expansion of output to 300,000,000 pounds.

The plant will use Lummus' ethylene process and will draw refinery gases supplemented with LPG from the nearby refineries of Cities Service and Continental Oil, by whom P.C.I. is jointly owned. Ethylene will be made in two grades — the top grade 99.8% pure — the second 98.5%. By-products will be 95% pure propylene, C_4s, and an aromatic distillate.

Cracking section of the plant features an improved Lummus heater which embodies years of research and development by Lummus' Heater Division. Equipment in the Lummus-designed low-temperature fractionation unit includes 12,500-hp gas turbines which drive the centrifugal charge and refrigeration compressors; exhaust from these turbines generates high-pressure steam in three waste heat boilers. The system utilizes high efficiency expanders to recover very low temperature refrigeration.

This plant brings the total of Lummus designed ethylene plants to 14, with a combined capacity of over 3 million pounds per day.

Part of the new plant's ethylene output will be sold to Calcasieu Chemical Corporation, which will use it to produce ethylene oxide and glycol in a plant adjacent to the ethylene unit. Lummus is currently designing and will build the Calcasieu installation.

Lummus has over half a century of experience with chemical and petrochemical projects. Why not discuss your next project with a Lummus representative.

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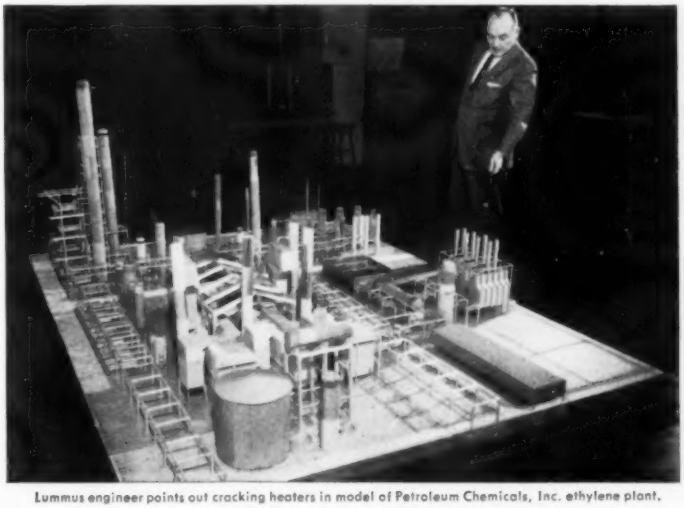

Lummus engineer points out cracking heaters in model of Petroleum Chemicals, Inc. ethylene plant.

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(To obtain more data on advertised products see page 158)

What route to higher octanes—isomerize or dehydrogenate?

BOTH cat cracking and cat reforming are nudging their octane limits, so cost-conscious refiners are eyeing light naphthas for octane boosting.

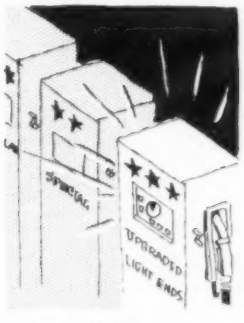
Four process licensors put their money on cat isomerization of pentanes and hexanes at the API's Division of Refining Meeting in Philadelphia.

Another licensor has a stake in cat dehydrogenation of pentanes, and one refining company reports advantages in cat dehydrogenative reforming of low-octane streams.

Isomerization's glamour comes from before-and-after comparisons of pentanes (normal-, 88.7; iso-, 108.5 RON + 3ml TEL), and hexanes (normal-, 65.3; isomers, 96.6-105.2 RON + 3ml TEL).

Actual octane improvement is modestly lower than the preceding examples, because of a large number of isomers and cyclics in the C_5 and C_6 straightrun streams. However, boosts of 10-20 octane numbers are possible for the C_5 and C_6 streams by isomerization, depending on the comparison of the feedstock and the method of operation (once-through or recycle). Liquid yields from isomerization are reportedly in the high 90%'s.

However, catalytic isomerization is not cheap. With reported investment costs of $400-500/bbl and operating costs of 16-30¢/bbl, its big appeal is the last few octanes it squeezes out of streams over 100 octane.



Available isomerization processes aired at the API meeting were Standard of Indiana's Isomate, Atlantic Refining's Pentafining, Universal Oil Products' Penex, and Kellogg's Iso-Kel. Except for Indiana's "aluminum chloride-hydrocarbon complex" catalyst, all of these processes use noble metal catalysts.

Catalytic dehydrogenation of virgin C_5 streams, using a chromia-alumina catalyst, was proposed by Houdry Process Corp. at the API meeting.

In one test, dehydrogenation of isopentane reportedly increased octane from 92.3 RON clear to 99 RON clear, with a C_5+ yield of 97%. Dehydrogenation after isomerization seems to offer maximum octane improvement for the pentane stream.

Dehydrogenative reforming, proposed by Sun Oil Co. at the API meeting, is reported to be an effective way of upgrading the octanes of "isomerization-proof," low-boiling, saturate fractions.

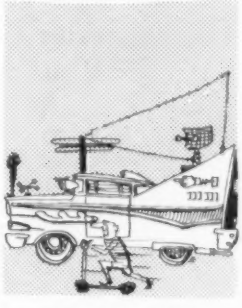
Feedstocks for dehydrogenative reforming are the C_6-C_8 saturates remaining from the manufacture of BTX aromatics, and the C_6-C_8 fraction from cat reforming of heavy naphthas. These streams are not readily improved by isomerization alone.

The process uses a chromia-alumina catalyst that upgrades the feedstock, primarily by aromatics and olefins formation. Yields of 80% of 95 RON + 3ml TEL debutanized reformate were reported for dehydrogenative reforming of 57.8 RON clear, C_6-C_7 saturates.

It's generally agreed that "something new" is needed in processing at the 100+ octane range. Will it be isomerization, dehydrogenation, dehydrogenative reforming or some dark horse process. The final answer might well be forthcoming in the next year or two. —R.L.D.

Automotive accessories to keep on gobbling horsepower

MUCH of today's passenger car ballyhoo suggests that drivers have all of the 200 or more horsepower now packed into auto engines instantly available to them on the highway.



Actually, part of the power has to be spent operating accessories, some necessary, and some not. More power is lost in the transmission, rear axle, bearings, tires, and in overcoming wind resistance. Authorities of the Society of Automotive Engineers, at a recent symposium on this subject, concluded that less than half of the engine horsepower is left for the driver on the highway.

The symposium discussed power losses in terms of a hypothetical, modern 200 hp passenger car engine. It was shown that, by the time the engine is installed, with muffler, air cleaner, distributor, all of which are necessary, and an allowance is made for combustion chamber deposits over the entire driving range, 16% of the bare engine power at 4440 rpm, has already been taken up. The first bite of the installed engine's power goes to the fan, the generator, and the power steering pump. The first two have been required for years, and the third is well on its way to becoming standard equipment because of customer demand. These basic accessories, together with the installation requirements, use up more than 25% of our hypothtical gross engine power.

In the speed range of the horsepower peak, the

available horsepower has dropped from 200 to 145. Another 7% may be spent in air conditioning. Transmission, axle, bearings, tires and overcoming wind resistance all create further power losses. By subtracting all resistance from the tractive effort, the engineers found that, at 50 mph, the driver has about 88 hp over and above that needed to maintain speed on a level road. He has the most surplus power in the 40 to 60 mph range, where it is most needed.

The public, currently supports the way horsepower is spent in today's cars. So, the trend will be toward showier cars, with more devices installed for rider ease and comfort. Gasoline economy will be mentioned respectfully but in small type in promotion pieces. —V.B.G.

Shale oil again seen possible source of petrochemicals

POTENTIALLY rich new sources for petrochemicals as well as conventional petroleum products are seen as strong possibilities with the opening of Union Oil Co.'s giant new oil shale research pilot plant in Colorado. (See "Shale Oil Research—King Size," p. 77, this issue.)

Union is investing $12-million for initial costs (plus an unrevealed amount for operating costs) in this venture. Its aim is to find a method for recovering oil from shale that is competitive with getting petroleum from the ground. Mining the shale is relatively simple, as is refining the shale oil. Once a method of recovery is found to be economical, the area, with its tremendous potential as a raw material source, promises to be intriguing to both petrochemical and petroleum processors alike.

Authoritative estimates indicate there could be over one trillion bbl of oil in Union Oil's area of operation—enough to last the United States well over 100 years. Unincluded are deposits outside of Colorado.

Experts studying the immediate future of a shale oil industry envisage an eventual production in Western Colorado of 2-million b/d.

Even if the shale oil is only processed, not refined, in Colorado, the by-products will be sufficient to form the basis for a very substantial petrochemical industry. Basic by-products from 2-million b/d would include 3700 ton/day of ammonia, 1700 ton/day of sulfur, 47,000 ton/day of coke, and one billion cu ft/day of refinery gas, as well as gas for fuel.

Ultimate future hinges of course, on economics. As pointed out in the article on p. 77, there are a number of important **ifs.** Yet Union Oil seems willing to bet a good-sized shirt on this region and on shale oil as an important source of petroleum. Cost figures are not yet known. But it's significant to note that finding and bringing in new crude oil has been jumping in cost. Ten years ago it was about 84¢ a bbl. Today the cost is close to $1.84. Trends like this can easily push shale oil to the foreground. —W.C.U.

Tomorrow's decision-makers may be playing games today

SOON we may be hearing oil company executives tell how the "hardest decisions" of their business lives were made over a game. This game, a very special affair, was designed by the American Management Association to flex and strengthen decision-making muscles of men with top management potential. It is built around a mathematical model of a hypothetical industry.

"Companies" in this industry are assigned to teams of managers, who then improvise strategy on the basis of information given about the market. Many years are compressed into a few hours of play. At each quarter of the "year" the teams decide what to spend for production, marketing, new plant, etc., and what to charge for their product. Consequences of each quarter's decisions are worked out for the whole industry by an IBM 650 computer. At the end, the team wins that has improved its company's financial position the most.

It's not a game of specialist skills, though. The AMA says that experienced businessmen have always done better than people who tried to solve the mathematical problem of the model rather than simulate the real-life business situation. What **is** important is the ability to see the complex whole of a business, with its many interrelated aspects, and to select the really important data from the mass of information available.

The AMA believes the game offers a way of learning how to make quicker and more efficient decisions with an overall view of the company. Training is the only use now developed for the technique, and the AMA will feature the game in a course on decision-making this summer. But with further experiment an analytical tool could also be developed, the AMA believes. We may see the day when the best plan for emergency shutdowns, for instance, is found by playing games. —S.D.B.

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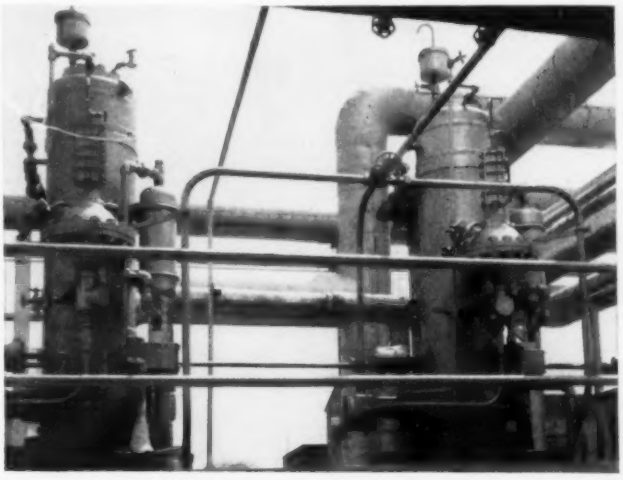

Battery of Bingham Type KT Stuffingboxless Pumps handling light hydrocarbon at low temperature, under high suction pressure. Tennessee Gas Transmission Co. plant, Gabe, Kentucky.

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Canadian Industries
Cities Service Company
Creole Pipe Line Company
Dow Chemical Co.
E. I. duPont de Nemours & Co.
ESSO Standard Oil Co.
Great Lakes Pipe Line Co.
Gulf Oil Corp.
Imperial Oil Company Ltd.
Mitsui Petrochemical Industries, Ltd.
National Petrochemical Co.
Polymer Corporation
Phillips Petroleum Co.
Stanolind Oil & Gas Co.
Sinclair Oil Company
Sohio Petroleum Co.
Standard Oil Company of Indiana
Tennessee Gas & Transmission Co.
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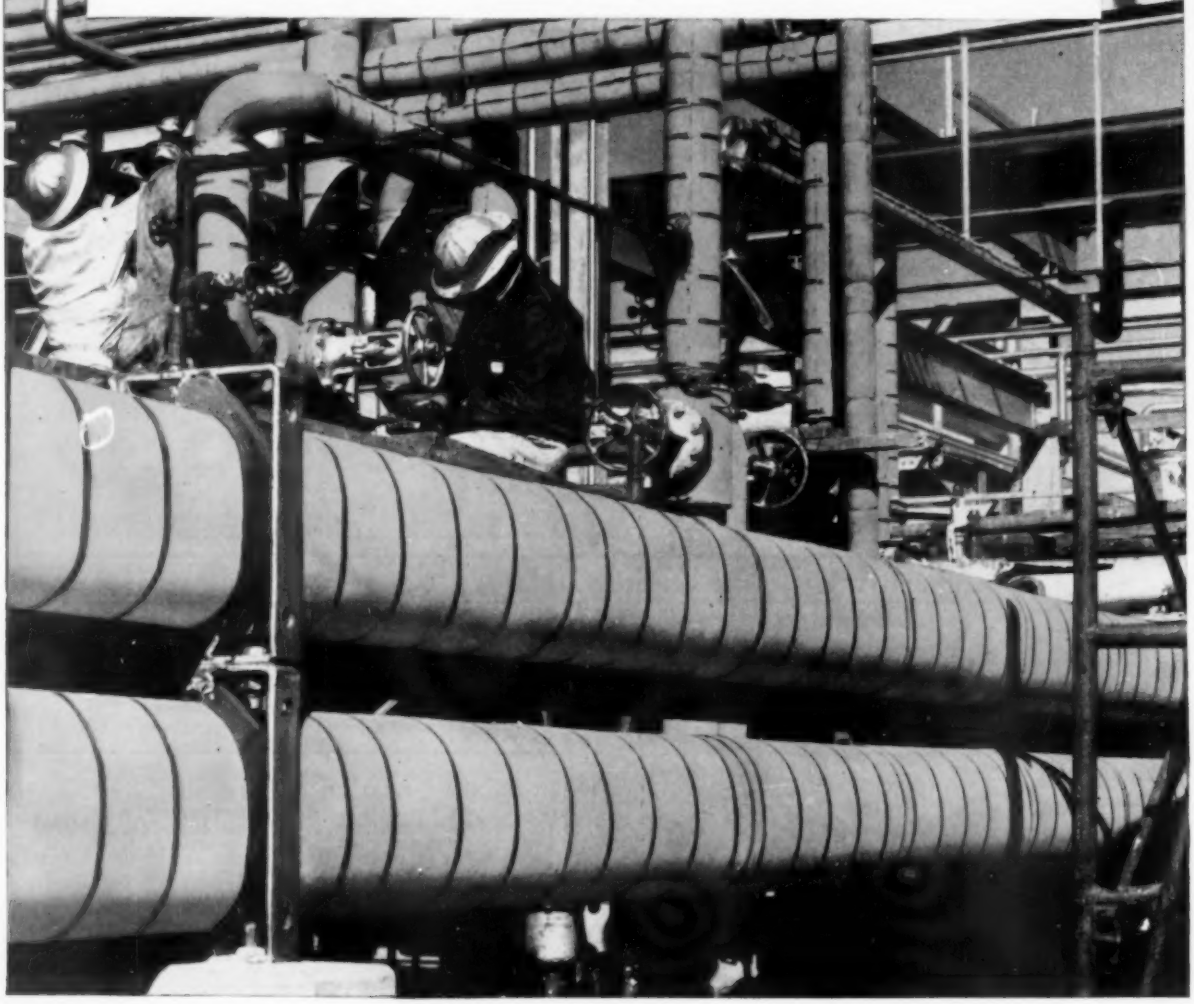
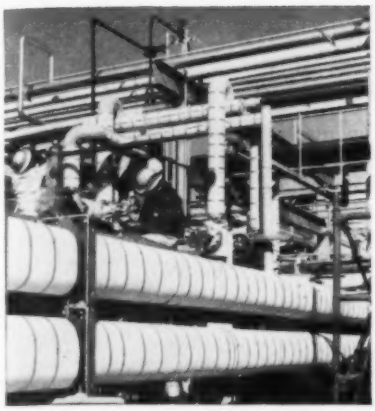


LETTERS



G-B SNAP-ON DISTRIBUTORS

(See ad on facing page)

ALBUQUERQUE, Mt. States Insulation Co.
AMARILLO, Ball Distributing & Engr. Co.
ATLANTA, Ga., Southern States Iron Roofing Co.
BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Shook & Fletcher Supply
Southern States Iron Roofing Co.
BROOKLINE, Mass., Homans-Kohler, Inc.
BUFFALO, Frontier Insulation & Supply Co.
CHARLESTON, W. Va., Baldwin Asbestos Products Co.
CHARLESTON HEIGHTS, S. C., Stafford Insulation Co.
CHARLOTTE, N. C., Guy M. Beaty & Co.
CHATTANOOGA, Guy M. Beaty & Co.
CHICAGO, E. C. Carlson Co.
CINCINNATI, R. E. Kramig & Co.
CLEVELAND, The Miles Materials Co.
COLUMBIA, S. C., Southern States Iron Roofing Co.
COLUMBUS, Santelier Brothers
DALLAS, Insulation Supply Co., Inc.
DAVENPORT, Republic Electric Co.
DENVER, Gene Wright Lumber Co.
DETROIT, Coon-DeVisser Co.
EL PASO, Insulation & Specialties Co.
FARGO, N. D., Smith, Inc.
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
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GREENSBORO, N. C., Starr Davis Co., Inc.
GULFPORT, Miss., Paine Supply Co.
HOUSTON, Precision Insulation Co.
INDIANAPOLIS, Central Supply Co.
JACKSON, Miss., Paine Refrigeration Supply Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Kelley Asbestos Co.
LITTLE ROCK, Gunn Distributing Co.
LOS ANGELES, Western Fibrous Glass Products
Thorpe Insulation Co.
LOUISVILLE, General Insulation & Roofing Co.
MEMPHIS, John A. Denie's Sons Co.
MIAMI, Southern States Iron Roofing Co.
MINNEAPOLIS, Asbestos Products, Inc.
MOBILE, Ala., Shook & Fletcher
NASHVILLE, Southern States Iron Roofing Co.
NEWARK, N. J., Eastern Steam Specialty Co.
NEW HAVEN, Conn., Insulation Supply Co.
NEW ORLEANS, Eagle Asbestos & Packing
NEW YORK, Eastern Steam Specialty Co.
OKLAHOMA CITY, Ball Distributing & Engineering Co.
OMAHA, Cardinal Supply & Mfg. Co.
PHILADELPHIA, John F. Scanlan, Inc.
PITTSBURGH, Dravo Corp.
PHOENIX, Ariz., Kircher Asbestos & Rubber Co.
RALEIGH, N. C., Southern States Iron Roofing Co.
RICHMOND, Va., Southern States Iron Roofing Co.
ROCKFORD, Ill., Mott Brothers Co.
SALT LAKE CITY, Bullough Asbestos Supply Co.
SAN ANTONIO, The Bracken Co.
SAN DIEGO, Western Fibrous Glass Products
SAN FRANCISCO, Western Fibrous Glass Products
SAVANNAH, Ga., Southern States Iron Roofing Co.
SEATTLE, Western Fibrous Glass Products
ST. LOUIS, A. G. Brauer Supply Co.
ST. PAUL, Asbestos Products, Inc.
SYRACUSE, N. Y., Industrial Supply Co.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TALLAHASSEE, Fla., Capital Refrigeration & Supply
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
WASHINGTON, Walter E. Campbell Co., Inc.
WICHITA, Jamar-Oimen Construction Co.
VANCOUVER, B. C., Fleck Brothers Limited

GUSTIN gb BACON

Change in name

To The Editor: We were very gratified to find the Marblette Corp. listed among materials suppliers in the "Clip-n-File" sheet on plastics in your February issue (EDS No. 14, p. 129).

However, there has been a change since the information was compiled on which your glossary is based. The "Marblette" trade name, listed for both groups of resins, now applies only to the phenolics. Our epoxy resins now bear the new "Maraset" trade name.

Stanley Ferber
MacLean Associates
New York 16, N.Y.

● *Thanks, Reader Ferber. Your letter emphasizes the problem engineers face in keeping abreast of trade names.*

Not THAT expensive

To The Editor: It was certainly interesting to me to see how four different publications presented my article on the costs of pneumatic control systems ("Pneumatic Control—in Cash," April, pp 97-101).

Frankly, I am of the opinion that the set-up you arrived at for this article was the most eye-catching and the easiest one to follow of all four. It was unfortunate, however, that the typesetter didn't do as good a job as the person laying out the material initially. An error was made in the cost figure in the fifth paragraph on p. 97 by a factor of 10, (the figure should have read $600 instead of $6000). And then again, on p. 98 in the third paragraph from the bottom, two lines of type appeared in reverse order.

Your use of the schematic drawings showing systems *A*, *B*, and *C*, was particularly good I thought, as well as the way in which you extracted other cost information, showing it in the proper place in your layout.

E. I. Thomas
Chief Instrument Engineer
Carbide & Carbon Chemicals Co.
So. Charleston, W. Va.

● *Thank you, Author Thomas, for spotting those two uncalled-for errors. Also, it is always good to learn that contributors support us in our approach to trying to make important and valuable technical data useful and easy-to-read. A small extra effort on our part pays off in value to the reader. We want to thank another reader, C. A. Prior, staff engineer with Diamond Alkali Co. in Cleveland, who also spotted the typographical error in the cost figure.*

Gaskets kudos

To The Editor: Your comprehensive coverage on "Gaskets" by Ron Cannon (March, pp 95-110) was a momentous achievement and appreciated by the gasket industry.

Congratulations on a job well done.

G. K. Mordas
Secretary
Metallo Gasket Co.
New Brunswick, N. J.

To The Editor: We liked your special report on Gaskets (March, pp 95-110). As a result, I asked my art director, Miss Peggy Rogginer, to draw up some ideas it gave me in cartoon form. You will note we picked up some of the bold-face type on p. 100.

Ralph Zimmerman
President
Zimmerman Packing Co.
Cincinnati, Ohio

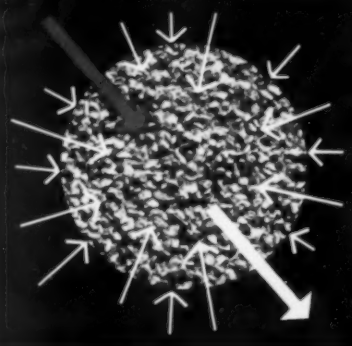
● *Thank you, Mr. Mordas and Mr. Zimmerman. If other readers agree, they can order extra copies of this report as Reprint* **R-43.** *See Reader's Service Card in this issue, pp. 159-160.*

Misplaced boundary

To The Editor: As a long-time resident of New Jersey and one who appreciates the lore and scenic beauty of the southernmost counties of my state, I would like to know just when Delaware stole this lovely area, as shown in the map on p. 78 in the March issue of PETROLEUM PROC-

MIN CHEMISTRY *at work*

case: how M & C materials and methods get the job done by sorption processing



Ad- or *ab-* . . . whichever prefix to sorption you prefer . . . M & C works with you to get the right balance of medium, efficiency, purity, treating conditions and economy.

Sorptive Mineral Report: M & C offers many grades for many jobs.

Molecules Out—you can refine, purify, decolorize; remove odors, colors, taste, moisture, acids, sulfur compounds, fluorides, unsaturates, many others.

Molecules In—other grades serve as carriers in scores of processes.

Anti-Caking—often 1% or less of specific sorptive grades make sticky, waxy, hygroscopic chemicals free flowing.

Drying—M & C desiccants dry air, hydrogen, CO_2, hydrocarbons, other fluids and gases.

Our business is to supply low-cost, nature-given materials that are *process-engineered* to make things go smooth in your plant . . . good in your markets. Use the coupon.

MINERALS & CHEMICALS CORPORATION OF AMERICA
3015 Essex Turnpike, Menlo Park, N.J.

I'm interested in a natural mineral product for_____

Send: ☐ Detailed adsorbent literature ☐ Free samples

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For more data, see Chemical Materials Catalog Pages 330-334

MINERALS & CHEMICALS
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3015 Essex Turnpike, Menlo Park, N.J.

Leaders in creative use of non-metallic minerals
ATTAPULGITE (*Attapulgus*)
ACTIVATED BAUXITE (*Porocel*)
KAOLIN (*Edgar • ASPs*)
LIMESTONE (*Chemstone*)
SPEEDI-DRI FLOOR ABSORBENTS

Letters (continued)

ESSING? I am right now preparing a report to the governor to notify him of this grand theft and you may be assured, sir, that we in New Jersey will call out our militia, close ranks, and fight to hold our ground!

J. S. Thompson

Cranford, New Jersey

● *We apologize to all New Jerseyites for the gross injustice to their property rights. Our only excuse: our mapmakers live in Manhattan and have never been west of the Hudson River. But that doesn't excuse our editors, who have visited New Jersey's refineries many times.*

Need writing help?

To The Editor: We are interested in obtaining reprints of an article which appeared in the April issue of PETROLEUM PROCESSING, entitled "How Well Do You Write?" Please advise us if reprints are available and their price.

J. B. Harkness
Manager
Houston Refinery Laboratory
Shell Oil Co.
Houston, Texas

To The Editor: . . . We believe the points brought out . . . are well worth passing along to some of our field men . . . perhaps you would be good enough to tell us just how we could go about getting extra copies.

J. M. Magowan
Grasselli Chemicals Dept.
Du Pont Co.
Wilmington, Del.

● *To these and similar queries, the reply is very simple. Reprints are available at 10¢ each. Turn to the Reader Service Card, this issue, pp. 159-160.*

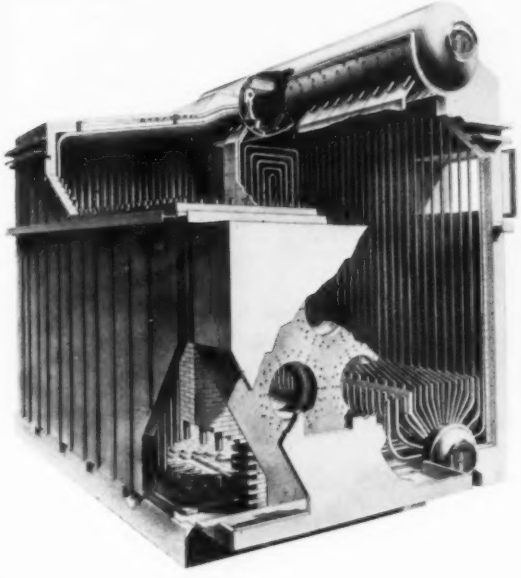
● ● ●

Here's why you get

IMPORTANT SAVINGS in

- ✔ *first cost*
- ✔ *installation*
- ✔ *operation*
- ✔ *maintenance*

with the FW Series "SC" STANDARD BOILER



THESE nine Foster Wheeler design features add up to substantial savings in the cost of steam generation. Equally important is the extra *dependability* that's built into every "SC" unit – the result of over 60 years of experience in the design and construction of large, high-pressure steam generators for leading central station power plants.

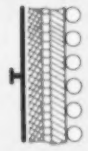
Pre-engineered in all details and standardized for economy, these FW standard steam generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F. For complete information, send for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

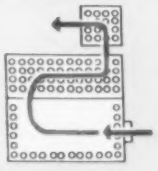
1. COMPLETELY WATER-COOLED WALLS

All furnace walls are cooled by closely-spaced tubes, minimizing setting maintenance and preventing excessive exit gas temperatures.



2. EFFICIENT FIRING ARRANGEMENT

Burner arrangement assures maximum rating without overheating furnace tubes. Rear wall is over 19 ft. from burner wall, permitting long, horizontal flame travel.



3. FULLY DRAINABLE SUPERHEATER

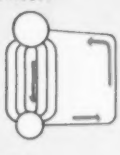
A completely drainable superheater permits removal of all condensed water from the elements before start-up.

4. HIGH STEAM PURITY

The normal drum internals consist of chevron dryers and a dry box. Separators may be added which make possible a steam purity of 1PPM or less.

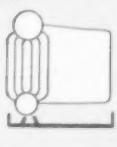
5. UNRESTRICTED CIRCULATION

Absence of headers provides free circulation through integral risers and downcomers, eliminating header handhole plates and gaskets.



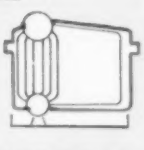
6. BOTTOM SUPPORTED UNIT

The bottom-supported design fully utilizes the structural strength of the tubes and provides low unit stresses in all members.



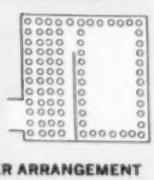
7. PRESSURE-TIGHT CASING

The all-welded casing forms a rigid, pressure-tight unit that can be arranged for pressurized or balanced draft operation.



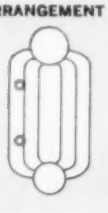
8. MINIMUM REFRACTORY BAFFLING

The wall separating furnace and boiler bank is the only refractory baffling used. It is completely accessible from the furnace.



9. SIMPLE SOOT BLOWER ARRANGEMENT

Soot blowers are supported on the outer row of boiler-bank tubes, simplifying alignment and providing easy access.



(To obtain more data on advertised products see page 158)

KEY® RETURN BENDS– KEY-KAST FITTINGS in service at new Tidewater refinery

In Tidewater Oil Company's giant new Delaware Refinery, where "firsts" are commonplace, and "world's largest" describes many of the units, **KEY** products were chosen for their efficient, economical, long-lasting service.

The furnaces are equipped with **KEY** 5000 Type Return Bends. Their simple design, rugged construction mean dependable service. Only 26 parts for 18 different size fittings in two series mean substantial savings in inventory. In addition **KEY** 180° type "W" welding fittings were extensively used.

KEY-KAST alloy steel welding fittings in ells, tees and caps were furnished in schedules 40 and 80, sizes from 16" to 24", in low chrome moly steel.

KEY Return Bends and **KEY-KAST** fittings are bringing dependability and economy to refineries throughout the world. Specify **KEY** and **KEY-KAST** products for your next job.

KEY PRODUCTS SPECIFIED FOR TIDEWATER REFINERY

KEY 5000 Type Return Bend
(PATENTED)

KEY-KAST 90° Elbows

KEY-KAST Tee

KEY-KAST 180° Return Bends.

5701

KEY Products on this project were supplied to

C. F. Braun & Co. • The Lummus Company
Foster Wheeler Corporation • Flori Pipe Co.

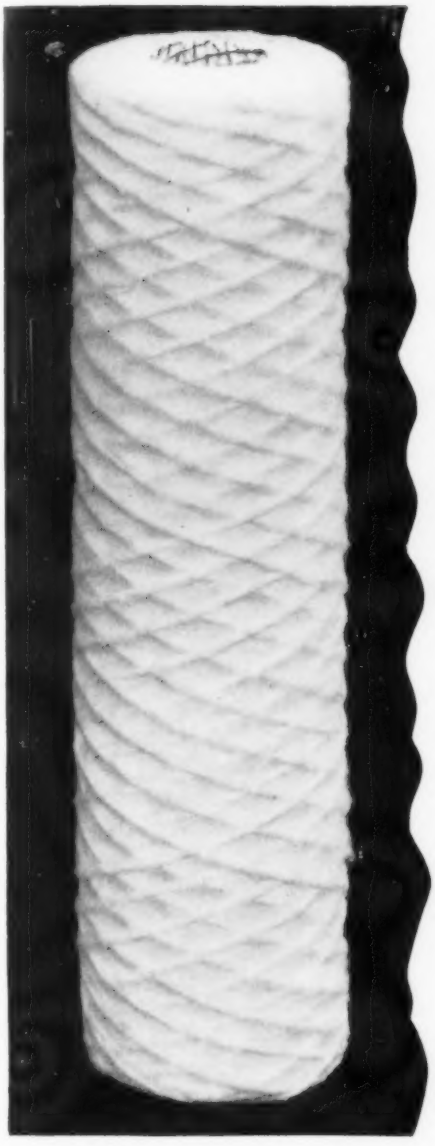
W-K-M

DIVISION OF ACF INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

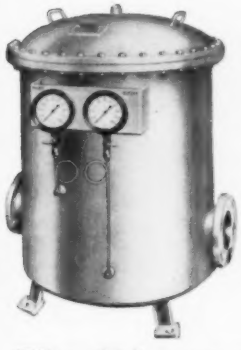
MANUFACTURERS OF W-K-M GATE VALVES · ACF LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS

(To obtain more data on advertised products see page 158)



The INSIDE story of *Fulflo Filters*

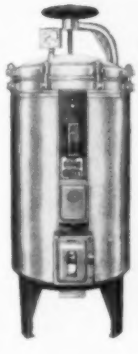
For Continuous Micronic Clarity



Inside every Fulflo Filter is the exclusive Honeycomb Filter Tube . . . engineered in a wide range of positively controlled densities to give you the exact degree of micronic clarity you want. Hundreds of filtering tunnels provide true depth filtration, at minimum pressure drop. Honeycomb Filter Tubes are made from cotton, nylon, orlon, dacron, dynel, acetate or glass fibres. Containers are manufactured from iron, steel, stainless steel, rubber-lined steel or nickel-plated brass.

Fulflo Filters clarify all kinds of petro-chemicals, gasolines, fuel oils, lubricating oils . . . in refining, processing, bulk filtration or dispensing. Special models can be engineered for almost any operating condition — high or low viscosity, pH, temperature — even for flow rates as high as 2000 gpm or pressures up to 5000 psi.

For engineering assistance or technical literature, write Department PP.



CFC

OIL FILTERS HAVE WIDE APPLICATION

CFC Oil Filters (including Honan-Crane models) provide selective filtration of virtually any oil under all operating conditions. Multi-Cartridge Filter (illustrated) gives you a choice of six interchangeable cartridges — inert media for solid contaminants, or Cranite (fuller's earth) for removal of both solid and dissolved impurities.

Micro-Fine Filtration for Low Cost Clarity

COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

FULFLO FILTERS WITH GENUINE HONEYCOMB FILTER TUBES FOR CONTROLLED MICRONIC CLARITY • CFC MULTI-CARTRIDGE OIL FILTERS
PURIVAC INSULATING OIL CONDITIONERS • DRI-PURE WATER-OIL SEPARATORS • PRE-COAT FILTERS • MAGNETIC SEPARATORS
AUTOMATIC TUBULAR CONVEYORS • COOLANT CLARIFIERS

J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10" steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

. . . and for low temperatures

. . . specify J-M Rock Cork insulation for service to −300F. Rock Cork retains its low conductivity at low temperatures. Offers long service life—high strength—ease of application.

JOHNS-MANVILLE PRODUCTS

Johns-Manville *first-in* INSULATION

MATERIALS · ENGINEERING · APPLICATION

(To obtain more data on advertised products see page 158)

REGENERATES IN SITU!

THIS IS THE CATALYST

Sinclair-BAKER RD 150
Platinum Reforming Catalyst

THESE ARE THE REASONS WHY

BAKER'S RD 150 continues to prove the most efficient of all reforming catalysts—producing important yield increases at high octane levels and high octane reformates from low grade naphthas.

The long period of initial operation is unmatched by any other catalyst . . . and beyond that, *RD 150 is regenerative in situ!* Cost is sharply reduced to lowest level.

RD 150, a joint development of Baker & Co., Inc. and Sinclair Research Laboratories is unique. It is being used in highly successful production by many producers in this country and abroad. A Baker representative will be glad to give you detailed information, upon request.

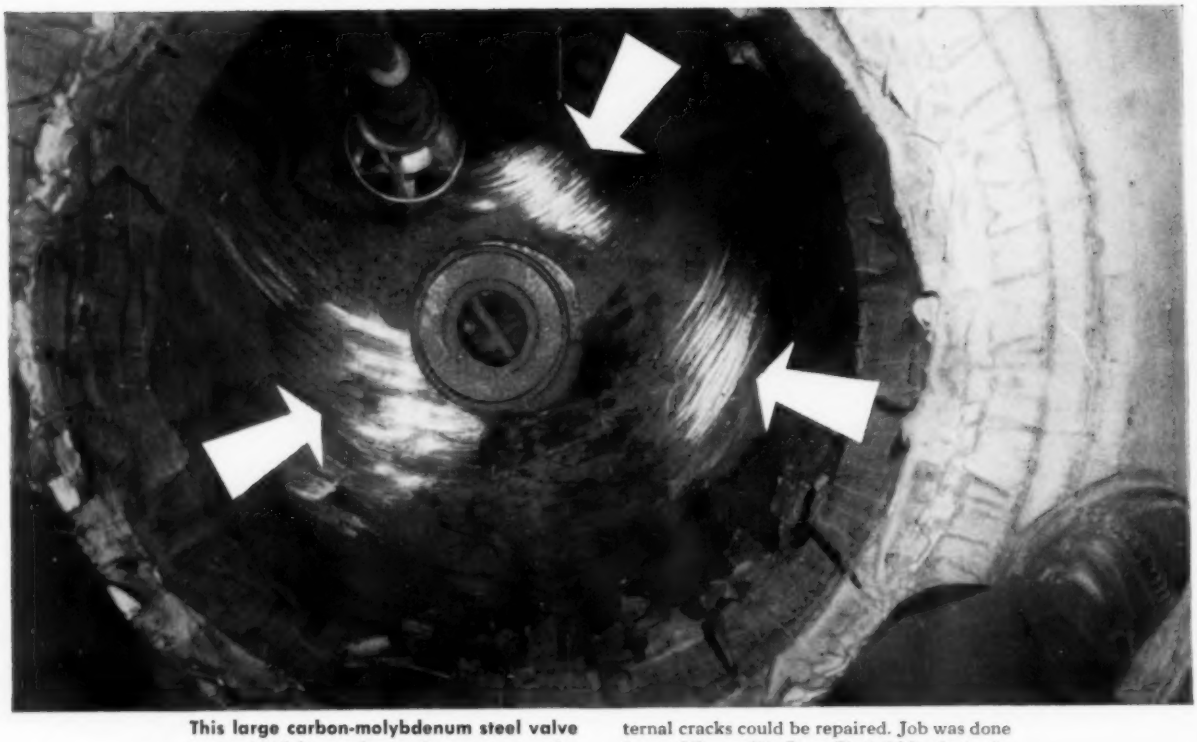
All data of confidential nature are of course treated accordingly.

SEND FOR BROCHURE
The Role Of Platinum Group Metals As Catalysts

BAKER & COMPANY, INC. CATALYSTS

BAKER & CO., INC.
113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO
ENGELHARD INDUSTRIES

THE HUB OF PLATINUM METALS RESEARCH



This large carbon-molybdenum steel valve was a total loss unless a dozen or more internal cracks could be repaired. Job was done by welding with Inco-Rod "A" electrode.

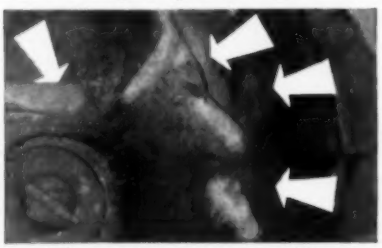
Preheat was impossible . . . yet Inco-Rod "A" saved this valve for Consolidated Edison

At first, repairing this throttle valve looked like a real headache to the Welding Department of Consolidated Edison.

The casting is made of carbon-moly steel. In service, a dozen cracks . . . some 3 inches deep . . . had developed inside its 4-inch-thick wall.

Ordinarily this would not present too great a repair problem. Use a carbon-moly electrode. To prevent air-hardening of the weld metal, *be sure to preheat to 300°F.*

But that was the catch! The valve was too big for preheating . . . and weldors would have to work inside.



A few of the cracks after welding.

Fortunately, Thomas Reilly, General Foreman, knew about Inco-Rod "A"* electrode. (Even with Inco-Rod "A" electrode, preheating is recommended when required to protect some base metals, although it is not needed for the weld metal itself.) Since the valve was a total loss, anyway, he decided it was worth a try to salvage it with Inco-Rod "A" electrode.

Working without preheat, weldors built up welds in the cracks. In a few hours the valve was saved. And today it's performing perfectly . . . operating at 925°F. and 1250 psi.

If *you* want strong, sound joints whether in repair work or in production welding of dissimilar alloys . . . consider Inco-Rod "A" electrode. A helpful folder, just off the press, gives you data on many test welds made with this electrode . . . informative case histories, too. Write today for your copy.

Inco-Rod "A" electrode gives these advantages

Versatility—This one electrode produces X-ray quality welds in *many* dissimilar alloy combinations: among ferritic and austenitic stainless steels . . . low alloy and mild steels . . . high-nickel, and other alloys.

Ease of use—With its spray-type arc, Inco-Rod "A" electrode is *easy*-handling in all positions. Slag removal is easy, too.

Corrosion resistance—Joints made with Inco-Rod "A". . . the electrode with the distinctive green flux coating . . . usually have equivalent or better corrosion-resistance than the alloys being welded.

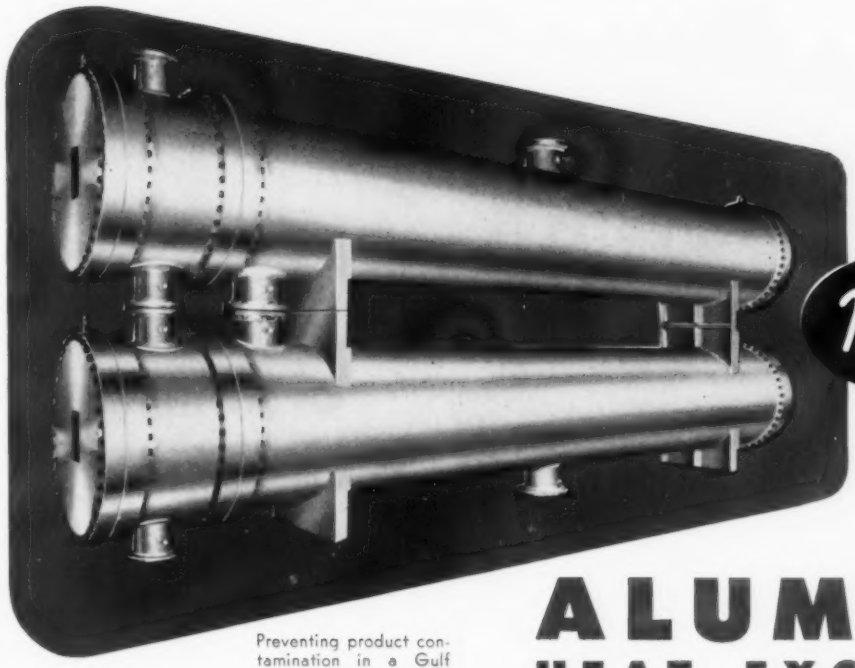
Registered trademark

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO-ROD "A" electrode is supplied in 14-inch lengths in four diameters, 3/32-, 1/8-, 5/32-, and 3/16-inch (the 3/32-inch is center grip) . . . packed in 5-lb. asphalt-lined containers.

INCO **Welding Products** • electrodes, wires, fluxes

(To obtain more data on advertised products see page 158)

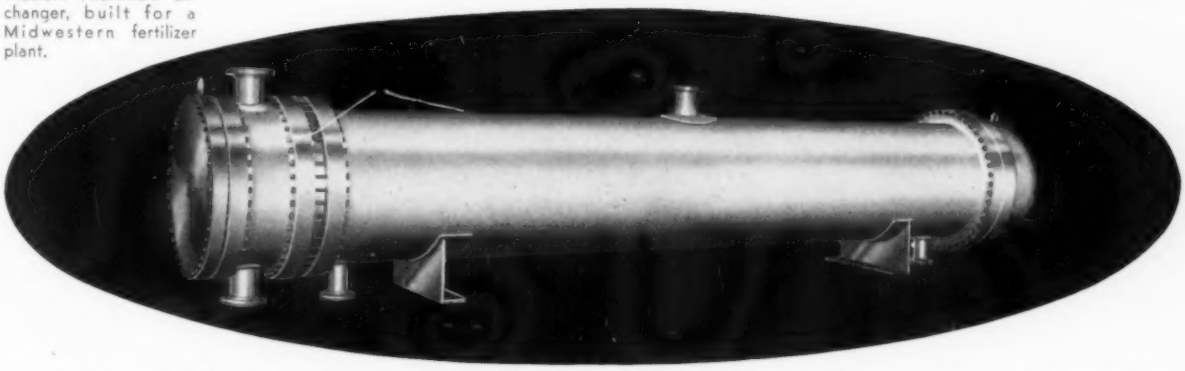


SPECIAL *Metallurgy*

ALUMINUM HEAT EXCHANGERS from WESTERN

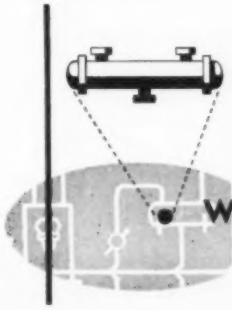
Preventing product contamination in a Gulf Coast high density polyethylene plant is the application for which these Western Aluminum Exchangers were designed.

Corrosion resistance to ammonium nitrate solutions is the job of this Western Aluminum Exchanger, built for a Midwestern fertilizer plant.



Exemplary of Western's experience in special alloy fabricating are these all-aluminum exchangers—wherein Western's metal inert gas and tungsten inert gas welding equipment, along with other specialized equipment and facilities—are utilized to produce heat exchangers specifically designed for handling specific corrosive fluids. Western's background in special metals has been successfully applied to Austenitic Stainless Steels—High Chrome Irons—Low Chrome Moly Steels—Monel—Copper Silicon—Nickel—and Aluminum.

You can profit from Western's extensive metallurgical experience. All we need is the opportunity.



WESTERN
HEAT EXCHANGERS
WESTERN SUPPLY COMPANY
P.O. Box 1888 – Tulsa, Oklahoma

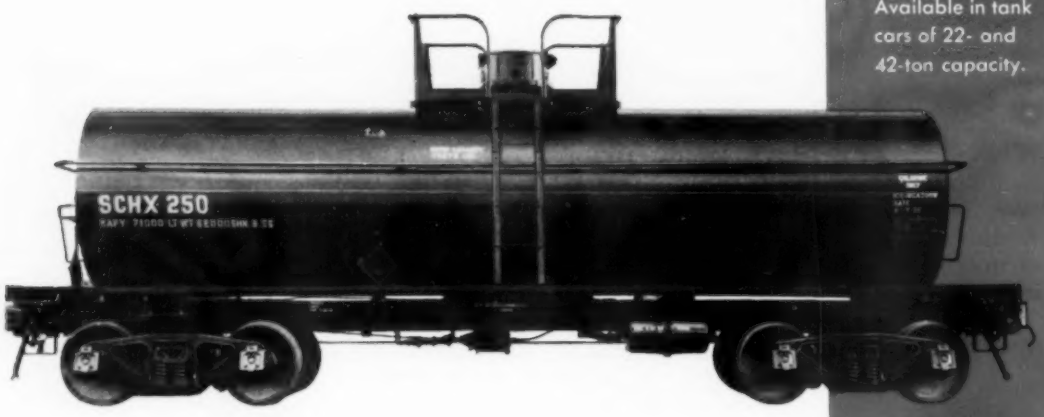
(To obtain more data on advertised products see page 158)

HF

HYDROFLUORIC ACID

anhydrous and aqueous

STAUFFER HAS IT...
IN QUANTITY AND QUALITY



Available in tank cars of 22- and 42-ton capacity.

STAUFFER CHEMICAL COMPANY

380 Madison Avenue, New York 17, N. Y.

Prudential Plaza, Chicago 1, Ill. • 636 California Street, San Francisco 8, Calif.

NYOTEX CHEMICAL DIVISION, P. O. Box 9716, Houston 15, Tex.

Stauffer CHEMICALS SINCE 1885

(To obtain more data on advertised products see page 158)

Unique combination of fine engineering and economy!

...the new FOXBORO M/44 INDICATING PRESSURE TRANSMITTER

- **Easier to Read . . . large indicator scale, visible at 20 ft.**
- **Easier to Calibrate . . . simple adjustments "on location"**
- **More Compact . . . single, integral instrument**

Any way you look at it, the new Foxboro M/44 Pneumatic Pressure Transmitter gives you an unmatched combination of fine engineering and economy. First; because it *is* an engineered instrument. There are no attachments or "makeshifts". Second; because it utilizes standard Foxboro parts throughout—parts which have been performance-proved in thousands of successful installations of other Foxboro Instruments. And this means not only top performance, but easier servicing and stocking as well. Third; calibration is simple, right in the field, because the M/44 is "convenience-designed" by men with years of experience in every phase of instrument design and application.

In appearance, too, the M/44 has unmistakable Foxboro quality. Features like the high-legibility indicator scale, the compact drawn-steel case with tough polyester plastic cover. It's the neat, high-efficiency, low-cost pressure transmitter for centralized operation or control. All standard ranges.

Write for complete details

THE FOXBORO COMPANY
916 Neponset Ave., Foxboro, Mass.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
REG U S PAT OFF

INSTRUMENTATION FOR INDUSTRY

Any Size...Any Design

Size or complexity makes no difference to the prompt and efficient service that The M. W. Kellogg Company offers to the process industries on heat exchangers. Whether it's an order for a single 14-ft. diameter giant, like the one above, or a group of normal size units, Kellogg's recently expanded facilities are geared to produce to the strictest design standards and delivery schedules. With these facilities, Kellogg can handle the complete job of designing, engineering, and fabricating heat exchangers, or make exchangers to customers' own designs.

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

711 THIRD AVENUE, NEW YORK 17, N. Y.

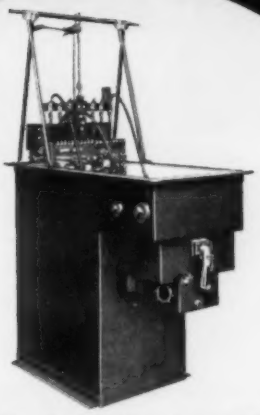
A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., New York
Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

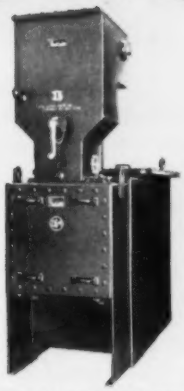
EC&M's LINE OF HIGH VOLTAGE STARTERS GIVES YOU

*EXACTLY the Right Starter for Any Location!**

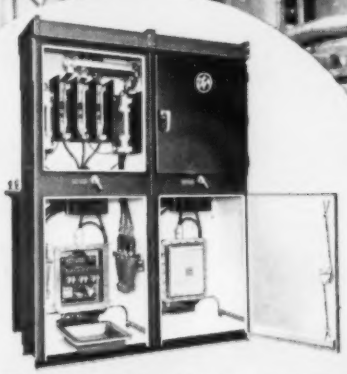
* Hazardous Location, Class I, Group D, Divisions 1 and 2



Type AT Combination Starter shown with Contactor and Overload Panel raised above the oil level without disconnecting any bolts or leads—in NEMA 3R enclosure for outdoor mounting, available in 50,000 KVA (certified) interrupting capacity.



Type AM Combination Starter in NEMA 3R enclosure for indoor or outdoor locations—available in 50,000 KVA (certified) interrupting capacity —and VALIMITOR.®



Type AH Combination Starter in NEMA 1 or 3R enclosures for indoor, outdoor or pressurized control room—available in 3 interrupting ratings, 50,000 KVA—POWER FUSED—and VALIMITOR.®

BETTER DESIGN

- EC&M 2200-4800 Volt Starters are compact...cut mounting space. Complete internal wiring reduces installation time.
- Fault currents cleared safely and quickly by high interrupting capacity contactors (certified rating of 50,000 KVA).
- EC&M provides the widest selection of starters for any location...and each is completely wired using anti-syphon wiring.

for complete information Write for Bulletin 8131-L

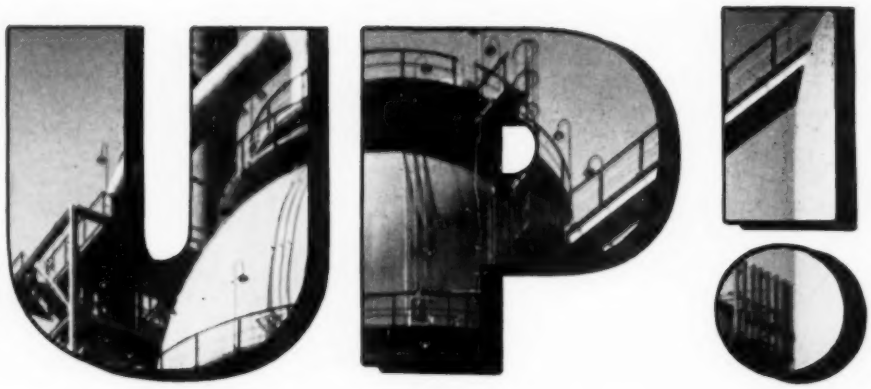
THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

CLEVELAND 28 • OHIO

7928

HOW TO KEEP PRODUCTION UP!



A few generations ago, John Ruskin had a few penetrating remarks to register on business—and what he said makes a lot of sense today.

"The common law of business practice," he commented, "prohibits paying a little and getting a lot. If you deal with the lowest bidder, it's well to add something for the risk you run. And if you do that, you will have enough left over for something better."

Let's translate this in terms of furnace construction for refineries. If you buy a heat enclosure for a job where high and continuous production is a must, then it's imperative that you invest in one that will stand the gaff. To make sure, you've got to build a unit which is properly engineered for the job it must do. You pay more, of course. But it's poor economy—and often embarrassing—to plow money back into repairs right at the peak of production.

That's all we have to say. You get sound engineering and a job designed to stay on stream when you come to Bigelow-Liptak. We've been designing refinery furnaces for years—erecting them, too. Both suspended and castable construction—the one that's best for the job—are used. Better investigate—right now!

FIRST COST OF AN INFERIOR JOB

PLUS REPAIRS AND LOST PRODUCTION

FIRST COST OF A BIGELOW-LIPTAK JOB

4350

BIGELOW-LIPTAK *Corporation*

AND BIGELOW-LIPTAK EXPORT CORPORATION

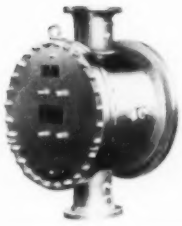
2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DENVER • HOUSTON • KANSAS CITY, MO. • LOS ANGELES • MINNEAPOLIS • NEW YORK PITTSBURGH • PORTLAND, ORE. • ST. LOUIS • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SAULT STE. MARIE, MICH. • SEATTLE • TULSA • VANCOUVER, B.C.

(To obtain more data on advertised products see page 158)



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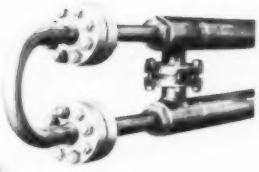

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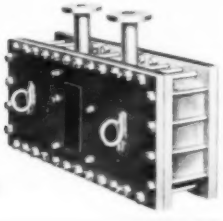

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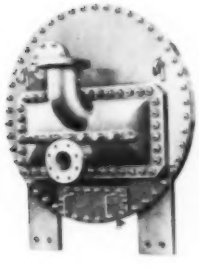

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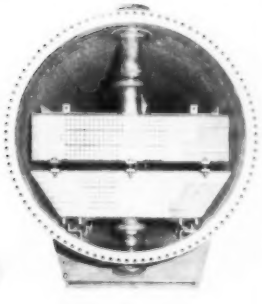

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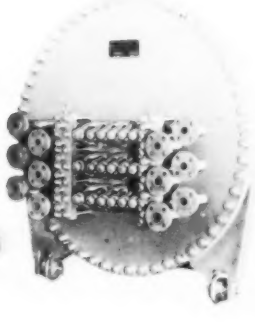


8

How many of these heads do you recognize

...they all belong to G-R heat transfer units

These are the heads of some of the many different types of heat transfer apparatus available from G-R. They indicate the wide range of G-R units . . . for condensing, cooling, heating or heat exchange . . . for any liquid, vapor or gas . . . for any capacity, pressure and temperature.

G-R designs and recommendations are backed by 90 years of G-R experience, the results of G-R continuous research and product improvement, and the performance records of many thousands of G-R installations throughout industry and all over the world.

Get the benefit of these assurances of authoritative advice and successful service for your particular heat transfer requirements. There's a helpful G-R representative near you. Write us about your needs and he will promptly get in touch with you.

1. Tubular Heat Exchanger, for a great variety of services in transferring heat from one fluid to another

2. Twin G-Fin Section, a unit with a wider range of heat transfer services than any other design on the market

3. Air and Gas Cooler, for cooling the air or hydrogen from generator windings and for other gas cooling or heating services

4. Atmospheric Open Section, with Bentube or K-Fin elements for cooling or condensing services

5. Type R Evaporator, for producing distilled boiler feed make-up at moderate pressures

6. Type I. Feedwater Heater, for the highest pressures encountered in central power generating stations

7. Type J-2 Evaporator, for producing large quantities of boiler feed make-up at high pressure

8. Steam Generator, using waste heat to produce steam at boiler pressure

THE GRISCOM-RUSSELL CO.

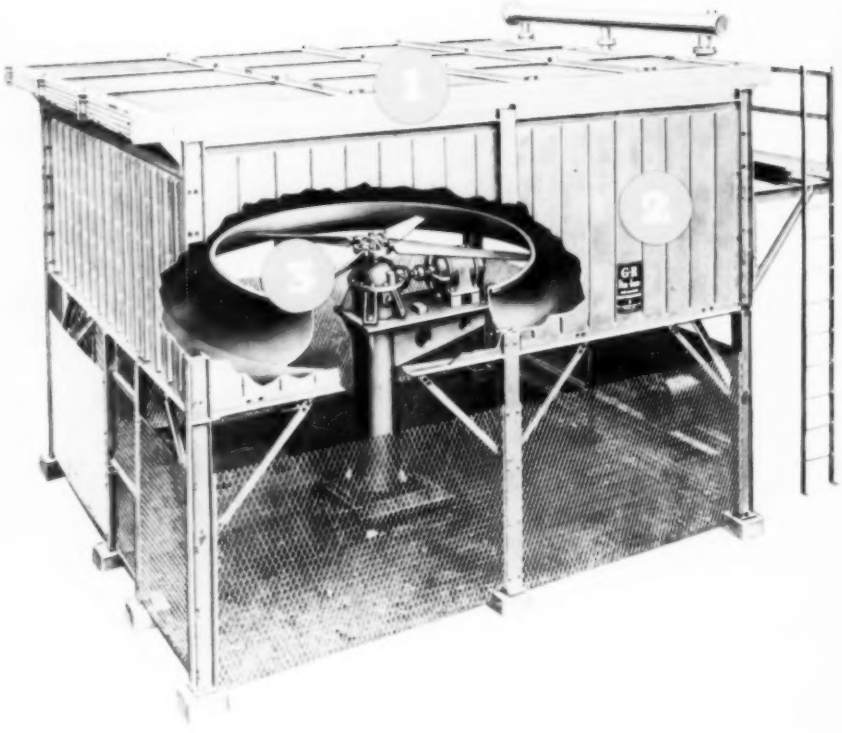
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

MASSILLON, OHIO

GR 358

fin-fan

the Sturdy air-cooled heat exchanger



Sturdy
K-Fin Cooling Sections

Designed for the highest pressures and temperatures encountered in cooling and condensing services, and for corrosive fluids—even hot liquid metal. Installations are operating at pressures up to 5,000 psi and temperatures up to 1,200 F.

Sturdy
Structure

Built to withstand a wind load of 40 lb per sq ft, equivalent to a wind velocity of 100 mph; and can be designed to withstand earthquakes.

Sturdy
Drive Mechanism

Driving units and speed reducers are specially designed for heavy-duty continuous operation, and are mounted on a sturdy pedestal with its own foundation, independent of the structure, for elimination of vibration.

You can confidently use G-R **fin-fan** for severe service conditions such as are often met in petrochemical plants and petroleum refineries. In addition to the exceptional sturdiness of every part of the unit, the design includes provisions for close temperature control and air-flow control, complete protection of operators and equipment, and wide selection of arrangements to suit plant conditions and operating requirements.

Write for complete information.

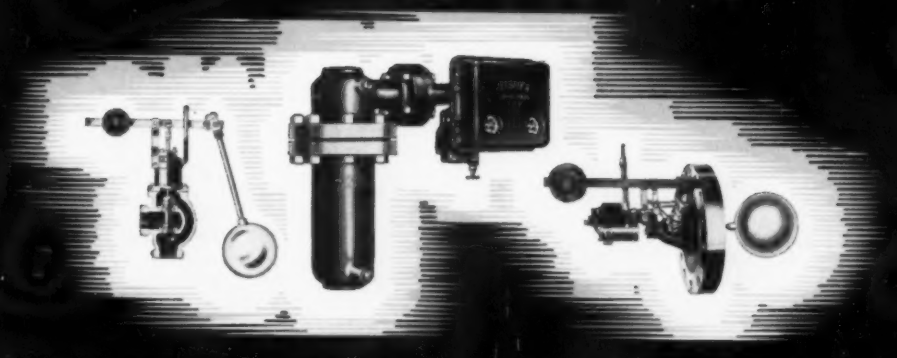
THE GRISCOM-RUSSELL CO.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

MASSILLON, OHIO

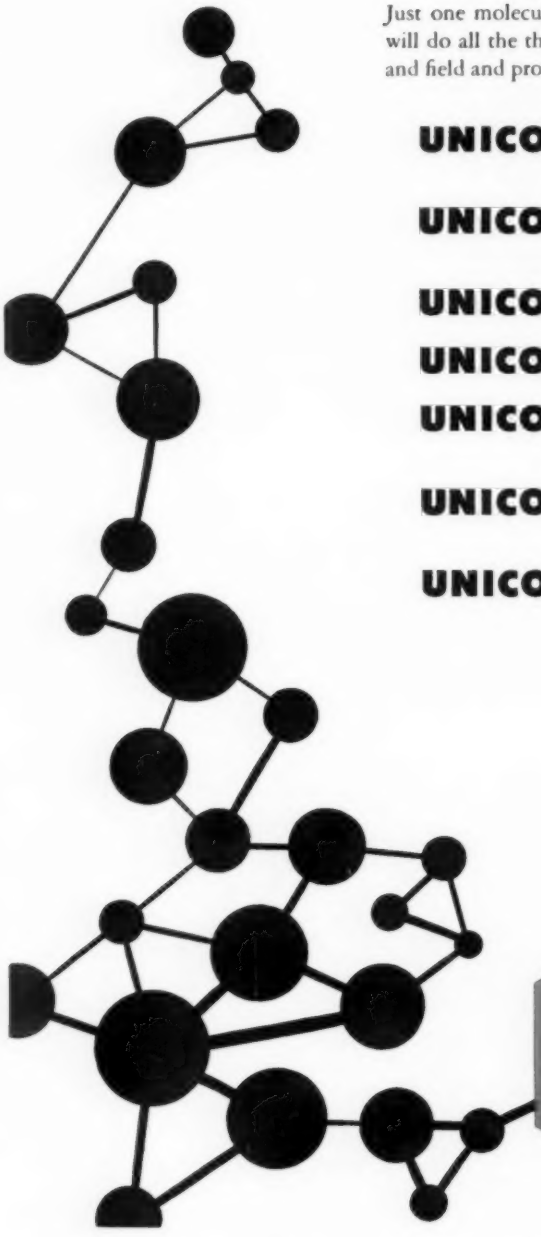
GR372

the tough Liquid Level Control jobs go to



FISHER GOVERNOR COMPANY
MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

1 in a million!



Just one molecule of Unicor to one million molecules of pipeline product will do all the things listed below. Unicor has been tested in both laboratory and field and proved to be superior to any other form of corrosion preventive.

UNICOR® prevents both aerobic and anerobic corrosion. Your tanks, vessels and pipelines are protected whether full, half-full or empty.

UNICOR is oil soluble and eliminates need for addition of destructive water. It prevents rusting caused by unavoidably entrained or dissolved moisture.

UNICOR is slime-detergent and anti-fouling. The water-repellent film it forms on pipe interiors sheds corrosive droplets.

UNICOR cuts downtime to a minimum, reduces filter replacement and the use of scrapers by at least one-half.

UNICOR will not interfere with action of other useful additives such as tetraethyl lead, antioxidants and dyes. It is approved for use in Air Force and Navy jet plane fuel.

UNICOR is added at only one point. Its beneficial effect will extend to pipelines, storage tanks, tankers . . . even to consumer equipment when added at the refinery.

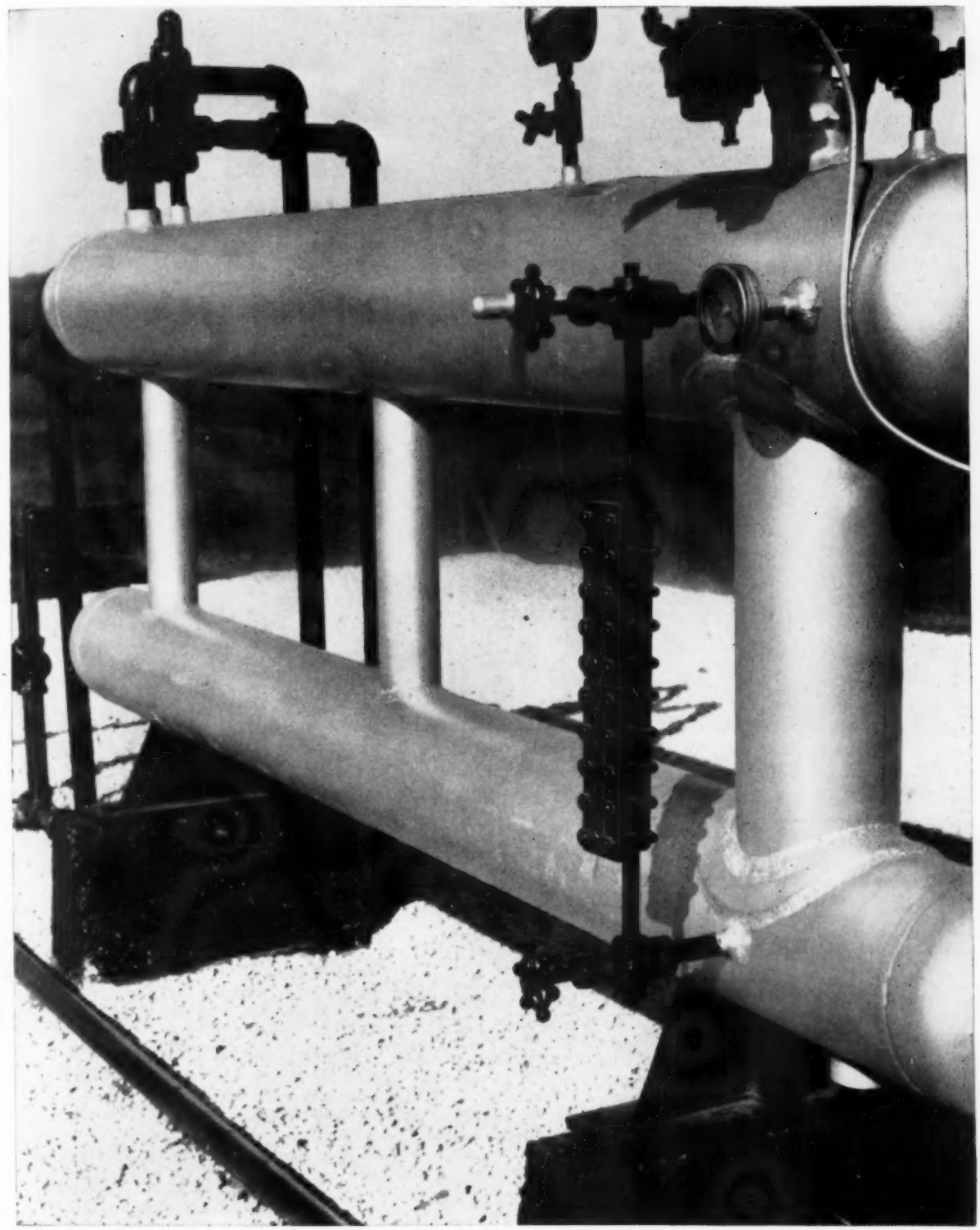
UNICOR is economical, costing only about $0.001 per bbl. of pipeline product. It has been approved for use in common carrier pipelines.

Sold exclusively by Universal Oil Products Company. For samples and information, write to:

UOP® UNICOR

PRODUCTS DEPARTMENT
UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road
Des Plaines, Illinois, U. S. A.

 (To obtain more data on advertised products see page 158)



● **PENBERTHY GAGES** on gas scrubbers on packaged gas booster units.
Continental Oil Co., Short Junction Booster, Cleveland County, Okla.

Everywhere... **YOU'RE SEEING MORE PRODUCTS BY**

PENBERTHY MANUFACTURING COMPANY
Division of Buffalo-Eclipse Corporation
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PENBERTHY

- **EJECTORS**
- **INJECTORS**
- **CYCLING JET PUMPS**
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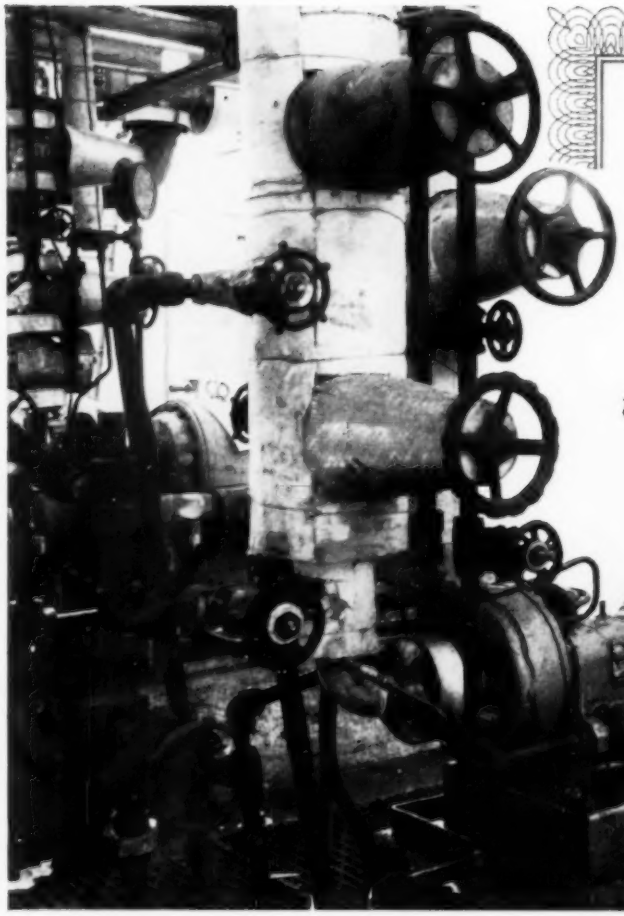
- **LIQUID LEVEL GAGES**
- **GAGE VALVES**

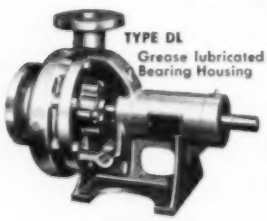


NOW—

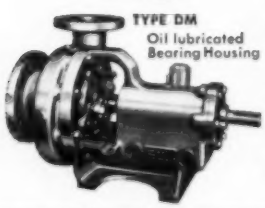
PEERLESS PUMPS COMBINES QUALITY *with* ECONOMY *in* PROCESS PUMPS

PEERLESS PUMPS

PUT THE IDEA OF PUMP COMPONENT INTERCHANGEABILITY TO WORK FOR YOU FOR SAVINGS IN FIRST COST— IN OPERATION—AND IN MAINTENANCE



TYPE DL
Grease lubricated Bearing Housing



TYPE DM
Oil lubricated Bearing Housing

Here's how component interchangeability works: Shown at the left are two types of Peerless chemical process pumps. The Type DL has a *grease* lubricated bearing housing; the Type DM has an *oil* lubricated bearing housing. To *either* of these bearing housings, you simply add the required backplate, impeller and volute. You "build up" the pump you want with either a water or air cooled backplate or an open or enclosed impeller.

In this way you match the temperature, pressure and other characteristics of the liquid being pumped. You "tailor make" the pump you want by complete component interchangeability—the Peerless idea—the modern idea in process pump buying.

Result: You stock up to 85% less parts; you reduce your capital investment; you obtain maximum versatility in pump application; you always pump with the most efficient pump for the intended service.

Write for NEW 12 PAGE BULLETIN, which completely describes and illustrates the Type DL-DM pump line, including specifications, dimensional data and performance charts. Use the coupon.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 WEST AVENUE 26, LOS ANGELES 31, CALIFORNIA

PEERLESS PUMPS fmc

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; San Francisco; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
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Consult your Telephone Directory.

☐ *Please send me Peerless Pump Bulletin No. B-1608*

NAME_____ COMPANY_____

ADDRESS_____ CITY_____ STATE_____

PP

(To obtain more data on advertised products see page 158)

This Complete Organization for Engineering and Construction of your plant is available on a **"SHORT-TERM LEASE"**

McKee
ENGINEERING &
CONSTRUCTION
Services

YOUR new-plant contract with McKee is a short-term lease on the specialized knowledge, diversified talents and half-century experience of one of the world's large engineering organizations. The photos above show only a part of the large staff of engineers, technical specialists, purchasing facilities and skilled construction personnel available to execute every detail of your project regardless of size or location.

Arthur G. McKee & Company • Engineers and Contractors

Headquarters: McKee Building • 2300 Chester Avenue • Cleveland 1, Ohio
Offices: New York, N. Y. • Union, New Jersey • Washington, D. C.
British Representatives of Metals Division: Head, Wrightson & Co., Limited
Canada: Arthur G. McKee & Company of Canada, Ltd., 372 Bay St., Toronto

No embrittlement! Lowest cost! ASME Code approved!

In the subzero operating range . . . Specify Alcoa Aluminum equipment and piping

The flow chart details a tonnage oxygen plant now in actual operation where process temperatures average below minus 300° F. Notice that virtually all of the equipment and process piping are ALCOA® Aluminum. There's a good reason: aluminum is the lowest cost metal able to perform satisfactorily at low temperatures.

At subzero temperatures, ASME code approved aluminum alloys suitable for welded construction display improved yield and tensile strengths with no reduction in ductility or resistance to shock loading (see graphs). There is no embrittlement!

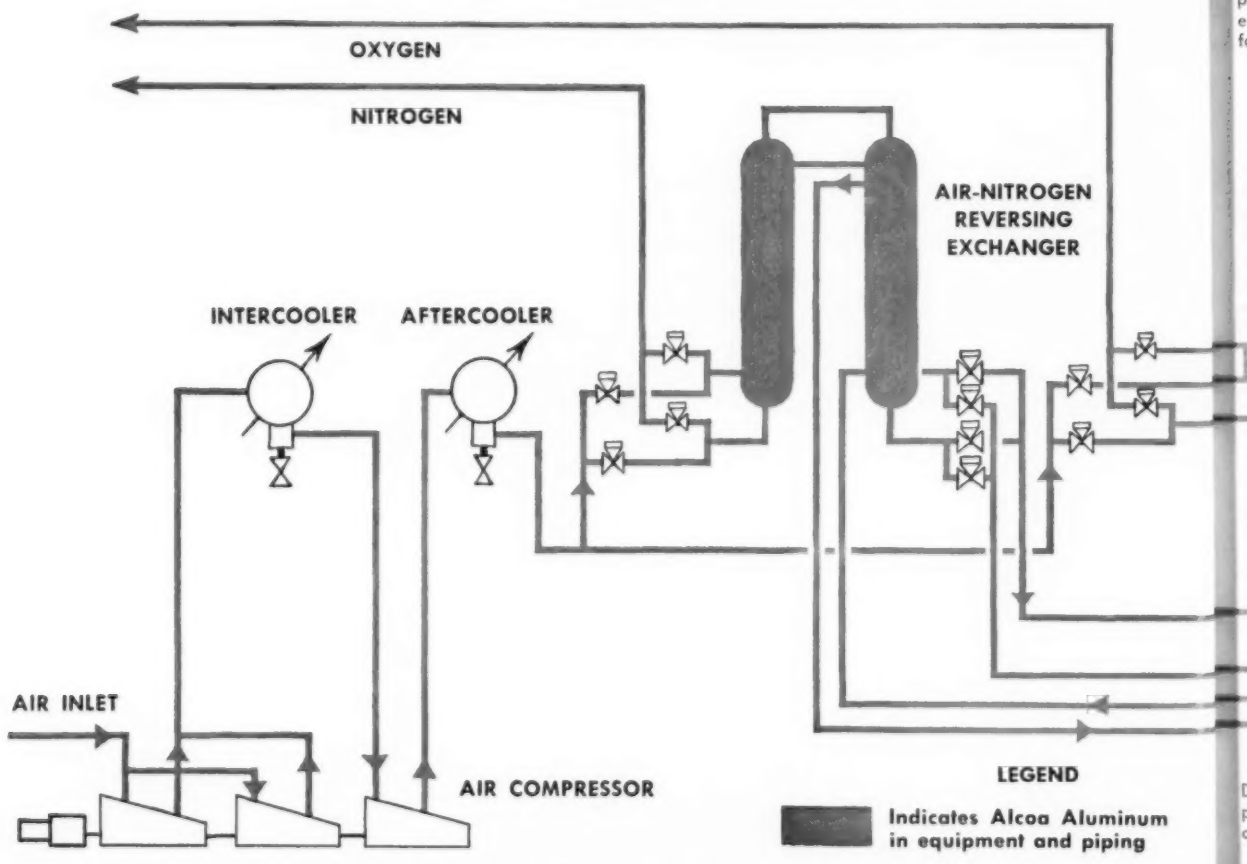
And in these operating temperature ranges, aluminum offers other valuable benefits . . . light weight . . . excellent resistance to corrosion . . . great strength in alloys . . . high thermal conductivity . . . nonmagnetic, nonsparking characteristics . . . nontoxicity . . . and excellent reflectivity. It is highly workable and lends itself readily to a variety of welding or brazing techniques for easy fabrication.

When *you* are looking for a low cost answer to the many problems of satisfactory equipment and piping performance in low temperature operations, *it will pay you to specify Alcoa Aluminum.* ALCOA engineers have worked with aluminum in the process industries for over 30 years. Use their accumulated knowledge to help you find satisfactory answers to *your* process equipment problems. Consult the nearby ALCOA sales office listed in the Yellow Pages of your telephone directory . . . or outline your equipment requirements in a letter to ALUMINUM COMPANY OF AMERICA, 893-F Alcoa Building, Pittsburgh 19, Pa.

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALCOA ALUMINUM

THIS FREE BOOK is filled with detailed data on the behavior of aluminum in the process industries . . . the result of more than 30 years of Alcoa engineering experience with aluminum in a variety of applications in nearly every temperature range. Use it as your guide to trouble-free, corrosion-free process equipment and piping. Write today for *Process Industries Applications of Alcoa Aluminum.*



(To obtain more data on advertised products see page 158)

LOW TEMPERATURE PROPERTIES OF ALCOA ALLOY 5154-0

Alcoa Aluminum actually increases in strength with no loss in ductility as temperatures drop to minus 320°F and below. Alloy 5154-0, for example, improves 50% in tensile strength, over 13% in yield strength and approximately 60% in elongation.

Photograph shows installation of Alcoa Aluminum equipment and piping in oxygen plant detailed in flow diagram. Harp-type heat exchangers (left) are dip-brazed assemblies with thousands of fins for best heat transfer.

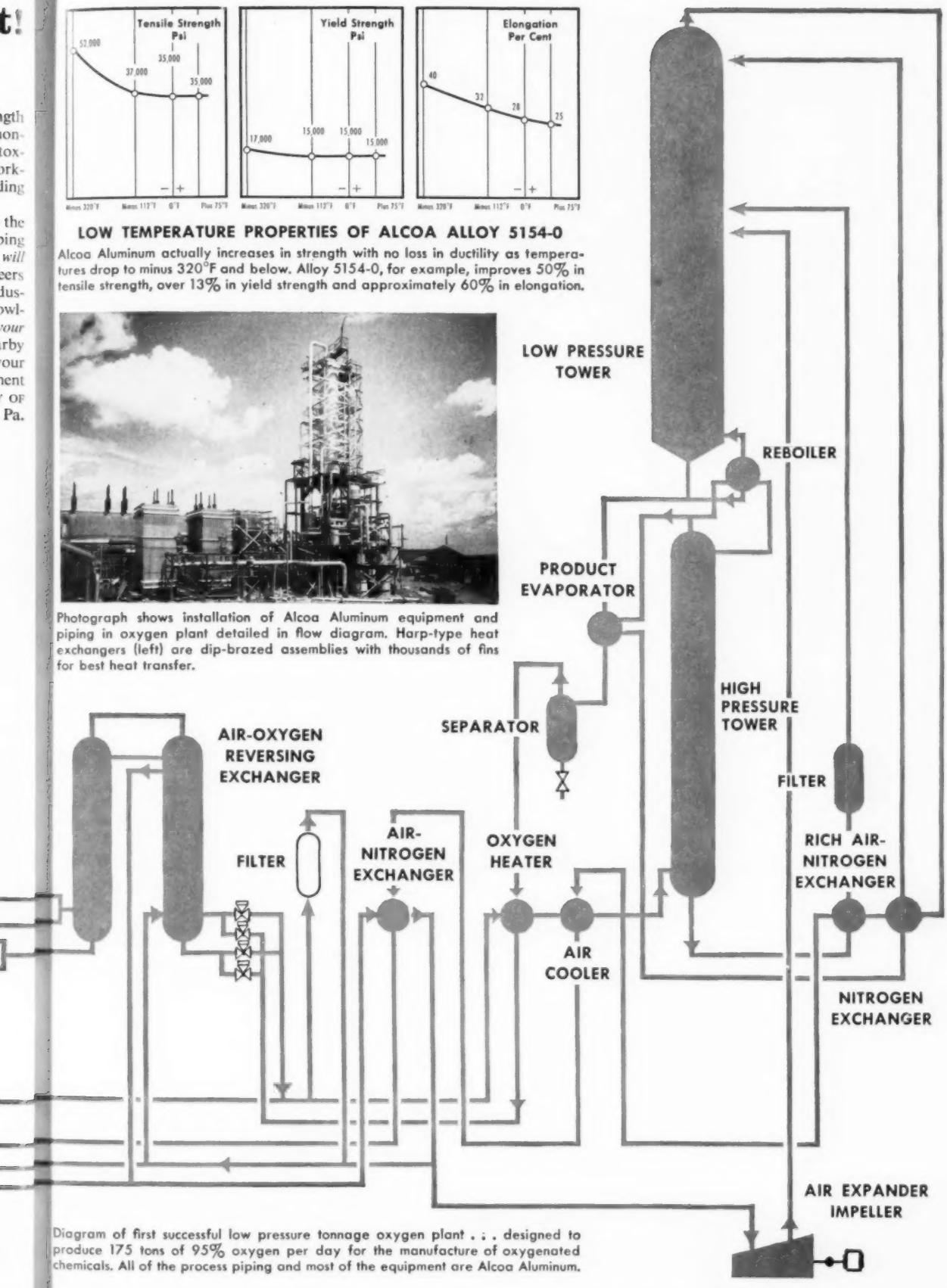
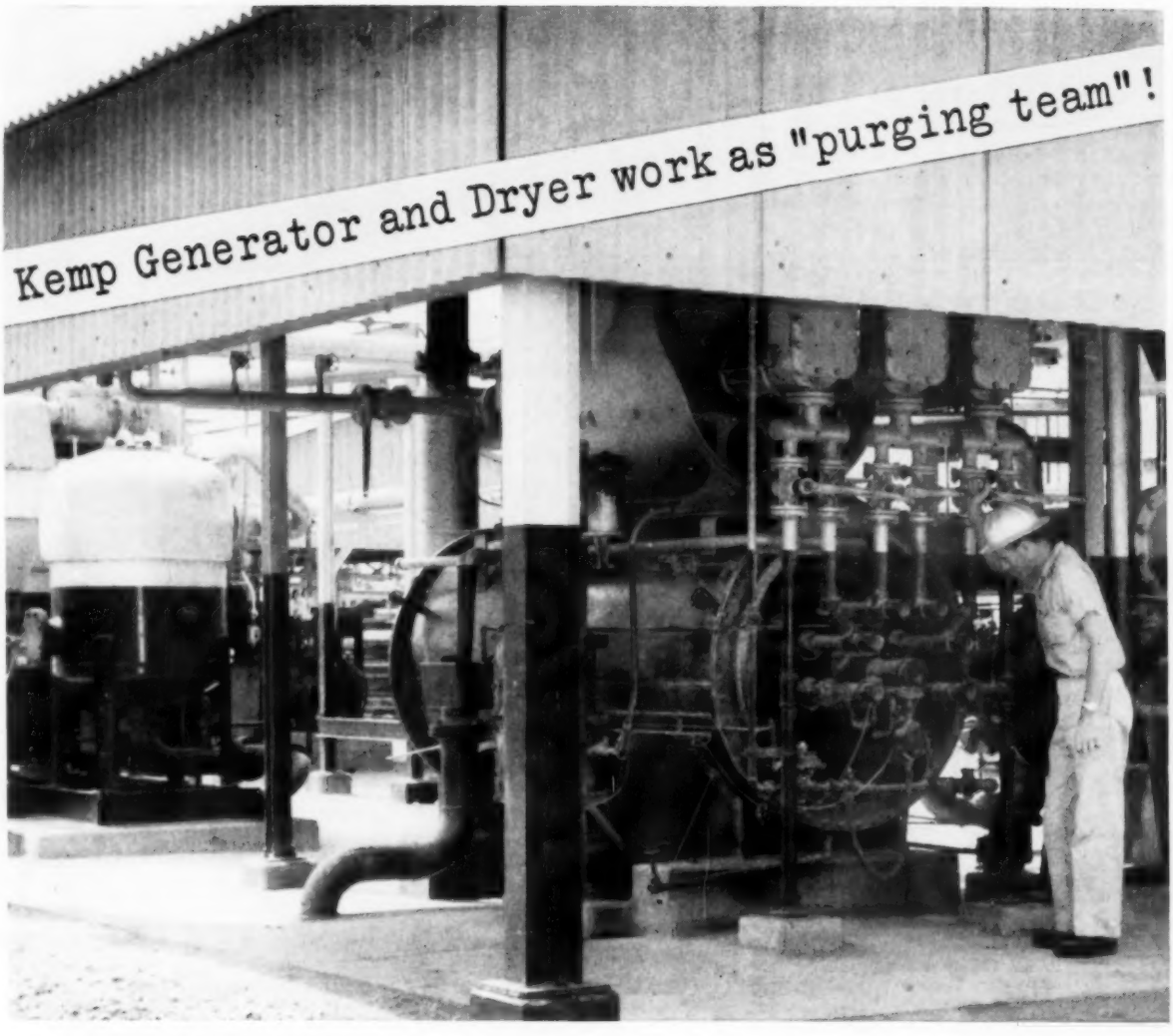


Diagram of first successful low pressure tonnage oxygen plant . . . designed to produce 175 tons of 95% oxygen per day for the manufacture of oxygenated chemicals. All of the process piping and most of the equipment are Alcoa Aluminum.

(To obtain more data on advertised products see page 158)



Gulf Oil Reports: *Pipe line purging problems solved by Kemp Gas Generator and Kemp Dryer*

At Gulf Oil's Port Arthur, Texas refinery, dry inert gas is required in the Ethylene Plant for purging pipe lines, tanks and vessels.

Kemp Units selected to do the job

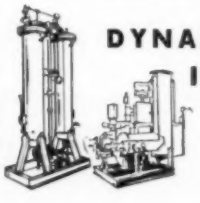
To insure a constant supply of gas—sufficiently dry and free of oil vapors—Gulf installed both a Kemp Inert Gas Generator and a Kemp Convection Type Dryer. The units work as a "purging team"...the Kemp Generator produces 30,000 SCFH of inert gas which is compressed and passed through a Kemp Pre-filter to remove all moisture prior to entering the gas receiver. The result is an efficient, easily controlled source of dry inert gas at all times.

Kemp can solve your problem too

Whether your needs involve dry gases, inert gases—or both, Kemp can help you to the most profitable solution. Kemp Inert Gas Generators automatically deliver clean, controlled atmospheres at specific analysis, without fluctuation—regardless of demands. A variety of Kemp Dryers are designed to dry air, gases or liquids to sub-zero dew points and are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will specify the proper desiccant for the job.

For complete facts and technical information on Kemp Inert Gas Generators and Kemp Dryers, write today to: The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Maryland.

KEMP OF BALTIMORE

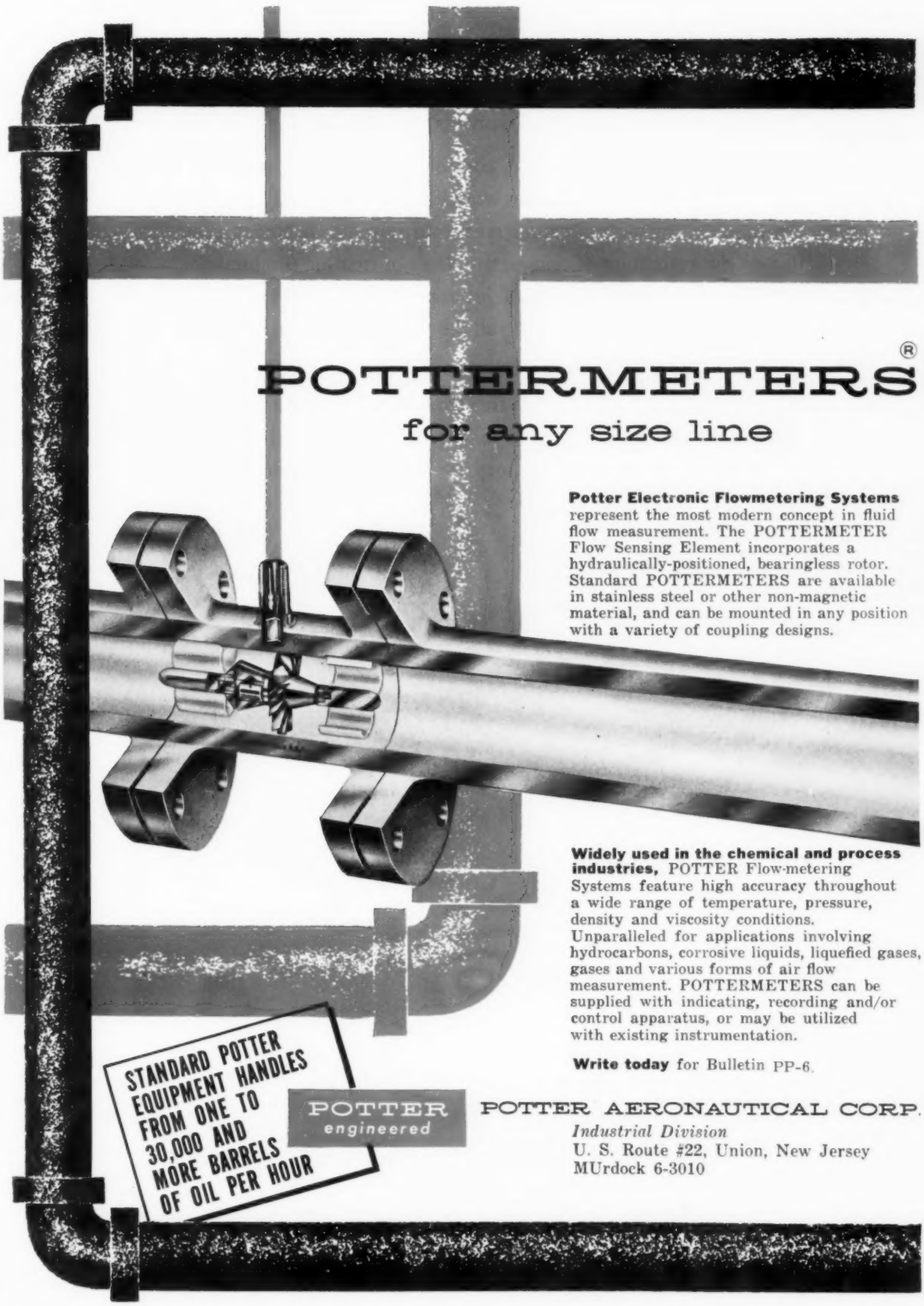


DYNAMIC DRYERS
INERT GAS GENERATORS
CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • SINGEING EQUIPMENT

(To obtain more data on advertised products see page 158)

POTTERMETERS®

for any size line



Potter Electronic Flowmetering Systems represent the most modern concept in fluid flow measurement. The POTTERMETER Flow Sensing Element incorporates a hydraulically-positioned, bearingless rotor. Standard POTTERMETERS are available in stainless steel or other non-magnetic material, and can be mounted in any position with a variety of coupling designs.

Widely used in the chemical and process industries, POTTER Flow-metering Systems feature high accuracy throughout a wide range of temperature, pressure, density and viscosity conditions. Unparalleled for applications involving hydrocarbons, corrosive liquids, liquefied gases, gases and various forms of air flow measurement. POTTERMETERS can be supplied with indicating, recording and/or control apparatus, or may be utilized with existing instrumentation.

Write today for Bulletin PP-6.

STANDARD POTTER EQUIPMENT HANDLES FROM ONE TO 30,000 AND MORE BARRELS OF OIL PER HOUR

POTTER engineered

POTTER AERONAUTICAL CORP.
Industrial Division
U. S. Route #22, Union, New Jersey
MUrdock 6-3010

Refining and research go together. The laboratory is vital to the successful operation of any oil refinery. That's why refiners, everywhere, have come to depend on UOP for many essential laboratory functions.

UOP laboratory service is broad, comprehensive, expert, providing vital information that in most cases would be impractical or economically impossible for the individual refiner to develop. It covers such specifics as the evaluation of crudes, problems of treating products for maximum stability, maintenance of product quality, performance of gas concentration equipment, answers all the requirements of a thorough and complete laboratory service.

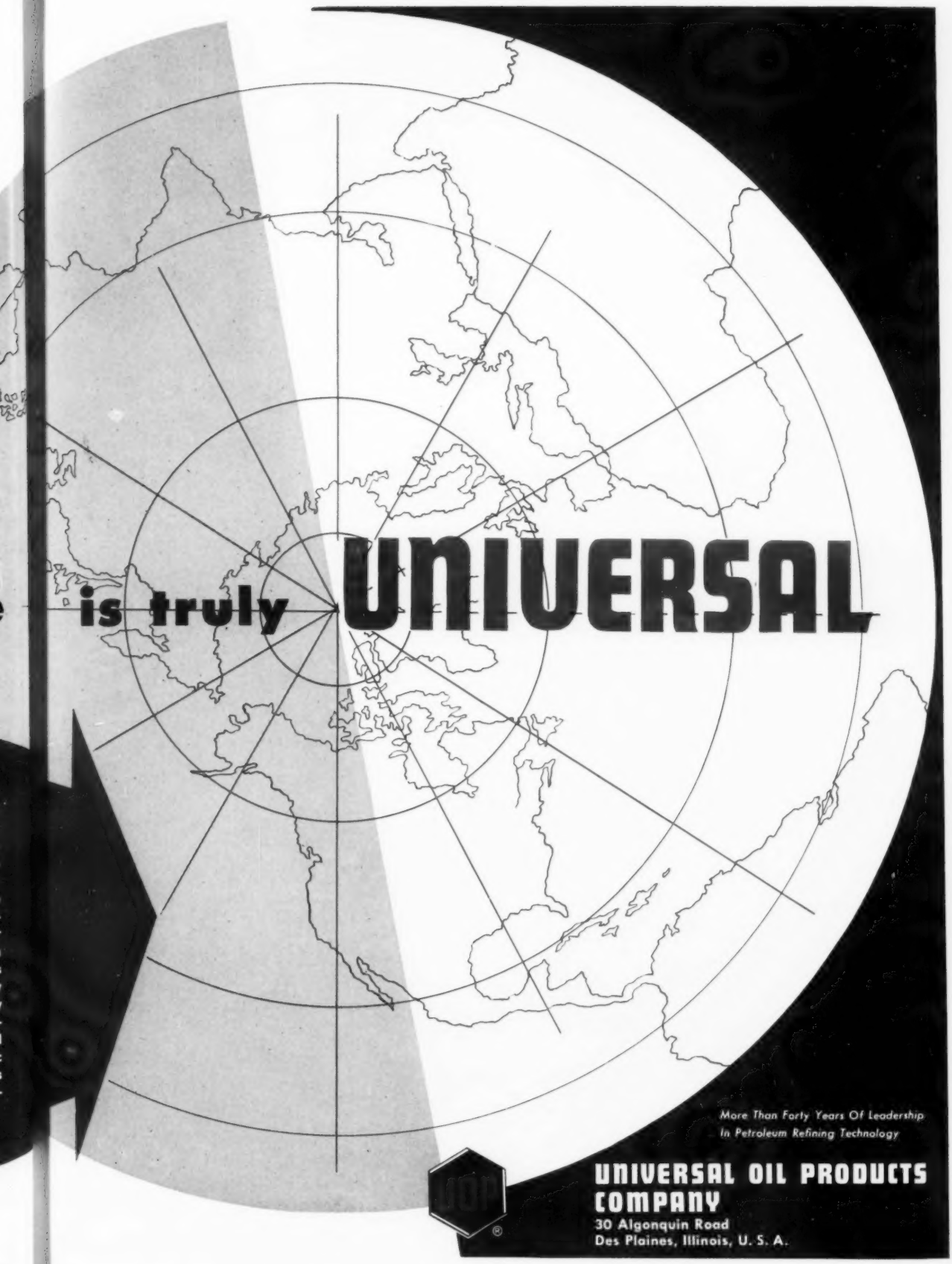
Today, refiners everywhere in the free world are users of this laboratory service. It is available to any refiner, regardless of his volume or scope of operation. UOP laboratory service is truly universal.

UOP

laboratory service

UOP Laboratories have available the most modern scientific research equipment. For example, here is one of two mass spectrometers, both of which are used for checking compositions of gas and liquids for laboratory customers. In actual operation the gas molecule is bombarded by electrons under carefully controlled conditions. Resulting fragments are sorted out by electric and magnetic fields, and recorded, thus revealing a pattern characteristic of each gas.

(To obtain more data on advertised products see page 158)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UNIVERSAL
More Than Forty Years Of Leadership
In Petroleum Refining Technology
UOP
UNIVERSAL OIL PRODUCTS
COMPANY
30 Algonquin Road
Des Plaines, Illinois, U. S. A.

you can meet any lubrication specification if you

BLEND WITH ENJAY PARANOX®

(DETERGENT-INHIBITOR ADDITIVES)

Blended with Paranox, lubricants can be compounded to combine *both* minimum wear and maximum engine cleanliness characteristics. That's why more and more refiners and blenders are relying *exclusively* on Paranox in formulating lubricants for heavy duty equipment and all engines that are subjected to tough operating conditions.

Through years of intensive research and development work with manufacturers and oil companies, Enjay has developed the only *complete line* of high quality additives (Paramins®) that can assure *maximum* performance characteristics. Why not let this experience and know-how work for *you*? Contact the Enjay Company today.

ENJAY

Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 WEST 51st ST., NEW YORK 19, N. Y.

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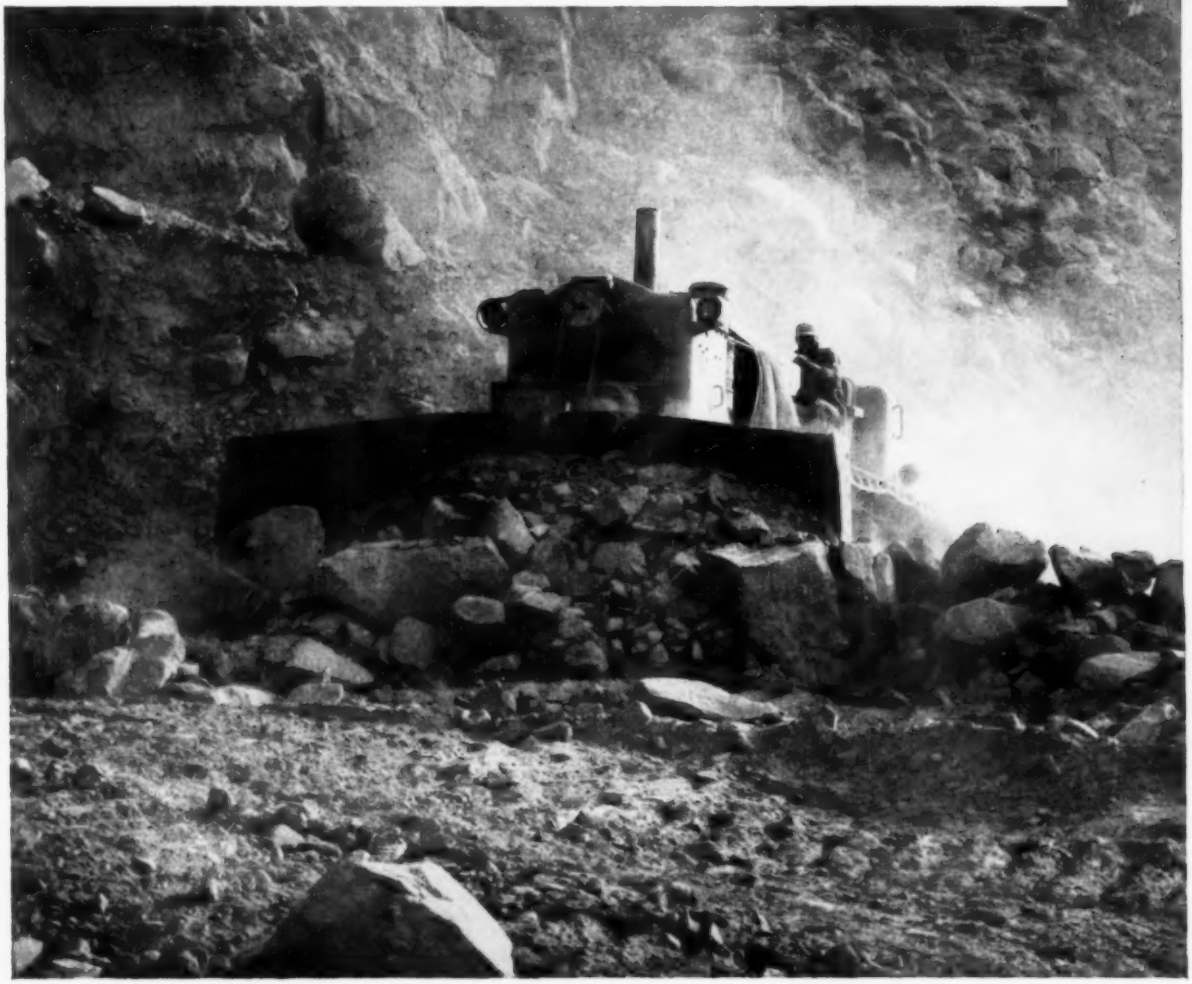


Anaconda Arsenical Admiralty-439 Tubes being installed in the condenser at the Shippingport, Pa., Atomic Power Plant–25 miles northwest of Pittsburgh.

CONDENSER IN AMERICA'S FIRST BIG ATOM POWER PLANT USES 60 MILES OF ANACONDA ARSENICAL ADMIRALTY TUBE

The electric generating station at the Shippingport, Pa., Atomic Power Plant will add a maximum 100,000 kw of electric power capacity to Duquesne Light Company's system when it is placed in operation this year.

More significant, however, is its function of measuring the performance of the Pressurized-Water Reactor. It will help give some of the answers on how to "burn" uranium on a large scale and utilize the power economically, to guide design of future atomic power plants.

A SKETCH of The Shippingport Atomic Power Plant, cut away to show containment vessels housing the pressurized-water reactor and heat exchangers which generate steam to operate the turbine-generator. The condenser is located directly beneath the turbine-generator shown in the background.

The Westinghouse Turbine-generator has a minimum rating of 60 megawatts and a maximum of 100 megawatts. It operates on saturated steam at low pressure–987,350 lb/hr at a throttle pressure of 620 Psia, for 79.3 megawatt gross generator load. It is served by a 70,000-sq.-ft. Westinghouse condenser which provides a condenser vacuum of 1.5 in Hg Abs.

The condenser has a total of 10,276 Anaconda Arsenical Admiralty-439 tubes, ⅞" O.D. x 18 Stubs' gage x 30 ft. long, with a total weight of 153,676 lb. The tube plates of "true oval shape," 153" x 213" x 1½" thick, are of Leaded Muntz Metal, each weighing approximately 12,450 lb. These, too, were supplied by The American Brass Company.

Oil Refineries have virtually made Anaconda Arsenical Admiralty-439 standard for refinery condensers and heat exchangers handling crudes, rerun stocks, cracked products, lubricating oils, and by-products. It is resistant to dezincification and can handle corrosive waters at relatively high temperatures. It can also withstand sulfur compounds encountered in refining sour crudes.

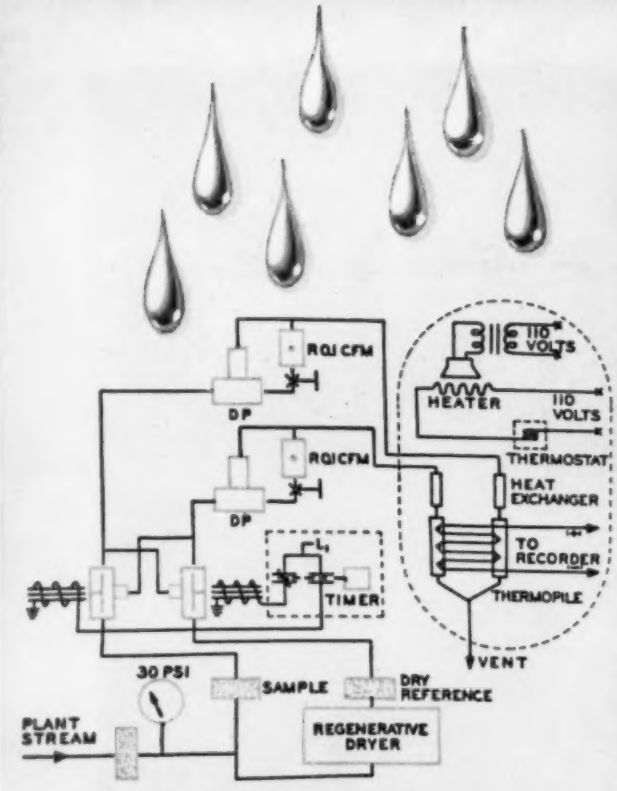
The American Brass Company laboratories are constantly studying corrosion problems to help make condensers and heat exchangers give longer and more dependable service—are leaders in the development of alloys to help meet the problems. Arsenical Admiralty is but one of its many contributions in the field.

TECHNICAL SERVICE. The Technical Department of The American Brass Company will be glad to help you select the one best alloy for the conditions you face. For such special service or for information on Anaconda Tubes and Plates, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5784P

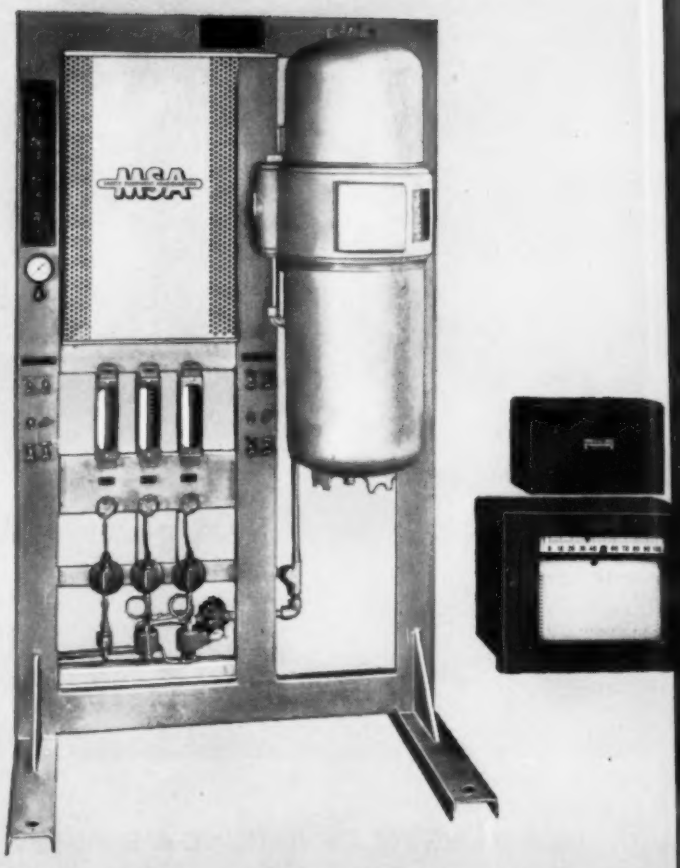
ANACONDA® **TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS**

MADE BY THE AMERICAN BRASS COMPANY

(To obtain more data on advertised products see page 158)



Schematic drawing above shows arrangement of the M-S-A Water Vapor Recorder.



The M-S-A Water Vapor Recorder operates on a new principle, based on measurement of the heat energy exchanged when a gas is adsorbed on or desorbed from the surface of a solid adsorbent.

M-S-A® Continuous Water Vapor Recorder detects trace moisture in air or gas streams

The M-S-A Water Vapor Recorder is an extremely accurate instrument which can solve a great number of moisture problems occurring in process industries as well as gas pipelines.

This unit continuously records low concentrations of water vapor in air or gas streams, and analyzes in the range of 0 to 10 up to 0 to 5000 ppm. It's particularly effective for monitoring natural gas in pipelines, thus avoiding undesirable moisture conditions. Of further value is the instrument's ability to maintain the efficiency of drying towers by monitoring effluent gases. This permits regeneration to begin just before or immediately upon the first water break-through.

This newly developed instrument is useful, too, for preventing moisture damage to process catalysts by monitoring feed streams, and for the detection of small amounts of water, so critical in controlling corrosion.

Typical applications for this dependable instrument include measurement of water or water vapor in streams containing: LPG, Ethylene, Natural Gas, Freon, Naphtha and other feed stocks. Write for our free bulletin for further information.

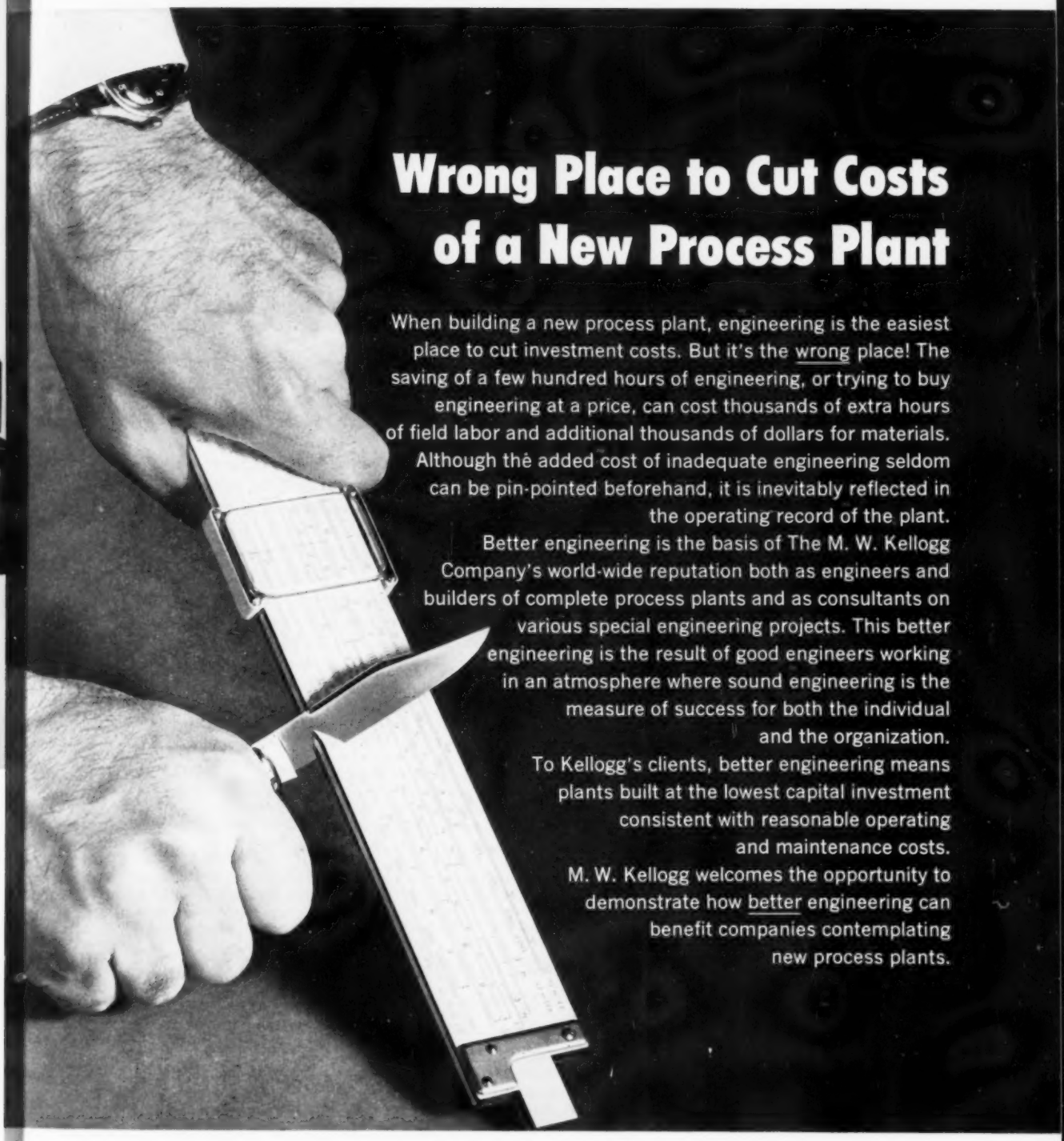
MSA

INSTRUMENT DIVISION

MINE SAFETY APPLIANCES COMPANY

Pittsburgh 8, Pennsylvania

At your service: 76 Branch Offices in the United States



Wrong Place to Cut Costs of a New Process Plant

When building a new process plant, engineering is the easiest place to cut investment costs. But it's the wrong place! The saving of a few hundred hours of engineering, or trying to buy engineering at a price, can cost thousands of extra hours of field labor and additional thousands of dollars for materials. Although the added cost of inadequate engineering seldom can be pin-pointed beforehand, it is inevitably reflected in the operating record of the plant.

Better engineering is the basis of The M. W. Kellogg Company's world-wide reputation both as engineers and builders of complete process plants and as consultants on various special engineering projects. This better engineering is the result of good engineers working in an atmosphere where sound engineering is the measure of success for both the individual and the organization.

To Kellogg's clients, better engineering means plants built at the lowest capital investment consistent with reasonable operating and maintenance costs.

M. W. Kellogg welcomes the opportunity to demonstrate how better engineering can benefit companies contemplating new process plants.

REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

711 THIRD AVENUE, NEW YORK 17, N. Y.

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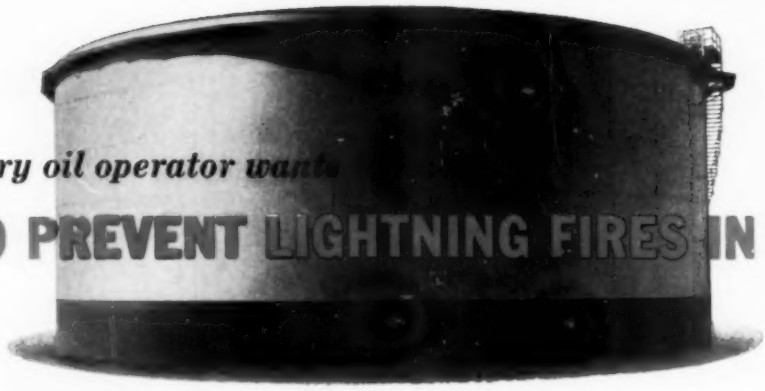
M KELLOGG W

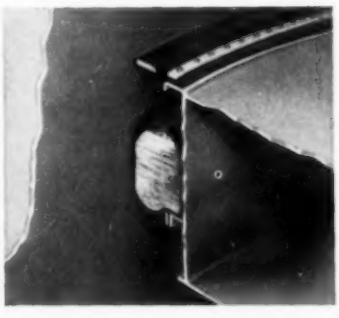


every oil operator wants

HOW TO PREVENT LIGHTNING FIRES IN TANKS

the answer is now available

USE HAMMOND TUBESEAL* FLOATING ROOFS!

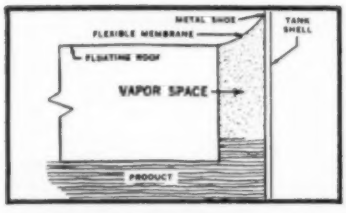


TUBESEALS are made lightning-proof with their exclusive electric conductor weather seal.[1] This specially compounded synthetic rubber, extending continuously around the entire perimeter, between roof and tank shell, provides an infinite number of contact points. ELABORATE TESTING by an independent laboratory[2] discloses that the seal prevents isolation and collection of static electricity charges, providing a continuous conductive surface with large current carrying capacity. Induced charges from lightning are immediately dissipated and fires are prevented. There are no mechanical contacts to cause sparking.

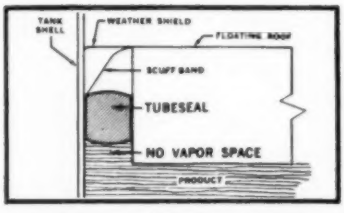
WITHOUT VAPOR THERE CAN BE NO FIRES. . . the inherent design and construction of Hammond Tubeseals eliminates space between roof, shell, and liquid; thus, there is no room for vapor to form . . . no vapor . . . no fires . . . no evaporation . . . no corrosion!

Introduced to the oil industry late in 1955, the Hammond Tubeseal found immediate favor with oil companies all over the world . . . there are now more than 200 installations in operation and building. A measure of their conservation values and fireproof features is illustrated by their record of repeat orders from satisfied users—one large oil company, after several test installations, re-ordered more than a score of Tubeseals. The same story of satisfaction exists wherever a Tubeseal is in operation.

Write for bulletin TS



CONVENTIONAL FLOATING ROOF tank has space below flexible membrane where air-vapor mixtures form. Because metal shoe and membrane cannot be absolutely gas tight, vapor is constantly escaping. This condition causes excessive corrosion, may also result in rim fires from lightning or other source.



HAMMOND TUBESEAL FLOATING ROOF entirely eliminates every space where air-vapor mixtures can form. Hammond Tubeseal completely fills space between product surface and roof seal, so that corrosion is stopped (even for sour crudes), and vapor cannot form—hence cannot ignite or be lost.

THE HAMMOND TUBESEAL
for new or old floating roof tanks,

FEATURES

- **lightning and fire proof construction**
- **no moving parts**
- **no mechanical maintenance**
- **climate-proof**
- **non-corrodible**
- **can operate to bottom of tank or above the top**
- **no vapor space below the seal**
- **entire circumference has tight seal under pressure at all times**
- **longer working life expectancy**

*Patented [1]patent pending [2]names on request

HAMMOND TUBESEAL — THE MOST EFFICIENT AND POSITIVE SEAL KNOWN

HAMMOND IRON WORKS

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(To obtain more data on advertised products see page 158)

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

JUNE 1957

World's first TEL tank-ship commissioned

NEW ASSISTANT REGIONAL MANAGER

WILLIAM W. WINGATE was recently appointed assistant regional manager in the Petroleum Chemicals Division's Mid-Continent Region, with headquarters in Tulsa, Oklahoma. He replaces Barrett B. Russell, III, who has been transferred to the Gulf Coast Region in a similar capacity.

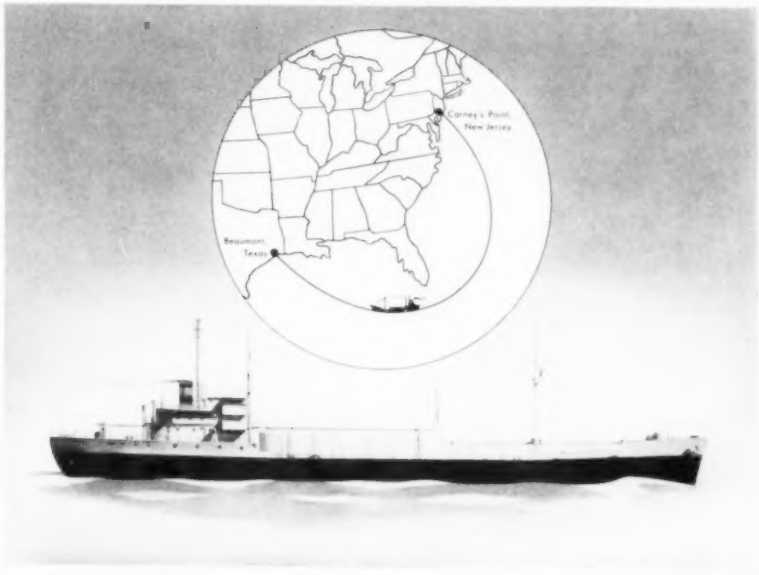
Previously Bill was active in regional sales and technical service work on all Du Pont additives other than tetraethyl lead. This includes Du Pont Estersil GT grease thickener, metal deactivators, lube and fuel oil additives, antioxidants, dyes and grease stabilizers.

Bill Wingate had an early introduction to the oil industry doing gasoline and lube oil testing for Socony-Mobil Oil Company, Inc. while earning his B.S. degree in chemical engineering at the University of Pennsylvania.

During World War II, Wingate was a lieutenant in the Navy and spent three years on submarine duty with the Pacific Fleet.

He is a member of Sigma Xi and Tau Beta Pi.

Rebuilt ship brings convenient Du Pont TEL supply to Gulf Coast refining area



MV PETROCHEM – the first chemical carrier for overwater transport of bulk shipments of TEL antiknock compounds. Rebuilt for the exclusive use of Du Pont, the 6,000-ton tank-ship was recently put into service to meet the expanding needs of Gulf Coast refiners.

SHIP-SUPPLIED STORAGE AND DELIVERY TERMINAL AT BEAUMONT COMPLETED

Another important TEL delivery convenience for Gulf Coast refiners became a reality with the recent rechristening of the MV PETROCHEM – the first TEL tank-ship. This unique ship makes possible a major source of Du Pont TEL supply right in the Gulf Coast area.

Also, TEL handling facilities have been constructed at Beaumont, Texas. These will provide dock accommodations for the new ship, and storage and distribution facilities for its cargo. Thus, the Beaumont terminal is equipped to provide the same TEL-availability and delivery service as Du Pont's manufacturing plants at Carney's Point, New Jersey and Antioch, California.

Bulk shipments

MV PETROCHEM'S maiden voyage marked the first time tetraethyl lead compounds have been transported over water in bulk. To accomplish this safely, the tanker was redesigned and rebuilt, from the hull up, to rigid Du Pont specifica-

OVER

DU PONT *Petroleum Chemicals* NEWS

Diesel locomotive fuel problem solved with Du Pont additive

R. R. SHOP SUPERINTENDENT:
Incompatible economy diesel fuels are causing injector-sticking and filter-plugging that cost us plenty in time and money.

OIL SALESMAN:
We've been hearing that lately. Incompatibility *is* the problem – but there's a way to solve it. I'll tell the refinery about it.

REFINERY EXECUTIVE:
Yes, I've been reading your ads telling how Du Pont's FOA-2 helps eliminate most diesel fuel incompatibility troubles. What about it?

DU PONT REPRESENTATIVE:
That's right, it does! Here, let me show you our data. I'll show your customer, too.

R. R. SHOP SUPERINTENDENT:
This injector's clean as a whistle—and it's been in operation 35 days.

DU PONT REPRESENTATIVE:
In most cases Du Pont FOA-2 keeps fuel oils gum-free. And while it helps prevent injector-sticking, filter-plugging it does not contribute to sparking tendency, because it burns without ash.

CONTINUED

Tanker shipments

tions—so rigid, in fact, that the PETROCHEM meets or exceeds the requirements of any port authority in the world!

TEL to Texas – raw materials back

The converted ship is in reality a two-cargo vessel. Designed primarily to move bulk shipments of TEL south from Carney's Point, it is also equipped with separate tanks for transporting ethyl chloride and ethylene dichloride back to Carney's Point.

Safety for crew and cargo

The PETROCHEM is permanently compartmented, with solid bulkheads dividing the operational and cargo sections. Still other solid bulkheads – welded to the hull itself—separate each of three cargo spaces. Safety and product cleanliness were the primary design considerations.

Unique features

Many new safety features were specially designed for this 6,000-ton tankship. Each compartment is ventilated separately by a system which effects a complete change of air throughout the entire ship every three minutes. A vacuum system is another of the many special facilities for safe maintenance, repair, and product handling.

If you operate a refinery in the Gulf Coast area, the new ship and terminal are your assurance of a nearby ample supply of Du Pont TEL.

Voice of America to broadcast Magic Barrel excerpts

Parts of the oil industry's "Magic Barrel" presentation have been recorded for broadcasting to people behind the iron and bamboo curtains as well as in free countries of the world.

Members of the Voice of America staff first became acquainted with the Du Pont-designed Magic Barrel when visiting the company to develop a special program using the voices of approximately 100 foreign-born and native American Du Pont employees. At this time, the Magic Barrel was shown to the Voice staff to acquaint them with the group of Du Pont products made from oil. They saw in this presentation some of the fruits of American enterprise – presented in a dramatic and convincing fashion. So they asked to have parts of it taped for broadcasting to their listeners.

The Magic Barrel broadcast has been included in a more comprehensive program in 32 languages under the title, "The People's Capitalism."

This program will also explain the widespread sharing of benefits under the American economic system and tell some of the history of the Du Pont Company. Recorded interviews with employees who emigrated from 44 foreign countries will appear on the program, along with company executives, scientists and union representatives. The interviews were all spontaneous . . . no prepared scripts.

The Voice of America program is the first concerted effort to tell the story of an American company in many languages.

SALES OFFICES

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Cleveland 15–25 Prospect Ave. SUperior 1-1363
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Philadelphia 2–3 Penn Center Plaza LOcust 8-3531
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San Francisco 4–111 Sutter St. EXbrook 2-6230
Seattle 3–4003 Aurora Ave. MElrose 6977
Tulsa 1–1811 So. Baltimore Ave. LUther 5-5578
In Canada–Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario HUdson 1-6461
In Other Countries–Petroleum Chemicals Division, Export Sales, 7447 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

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Better Things for Better Living
. . . through Chemistry

E. I. DU PONT DE NEMOURS & CO. (INC.) • Petroleum Chemicals Division • Wilmington 98, Delaware

OVER

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A-4635

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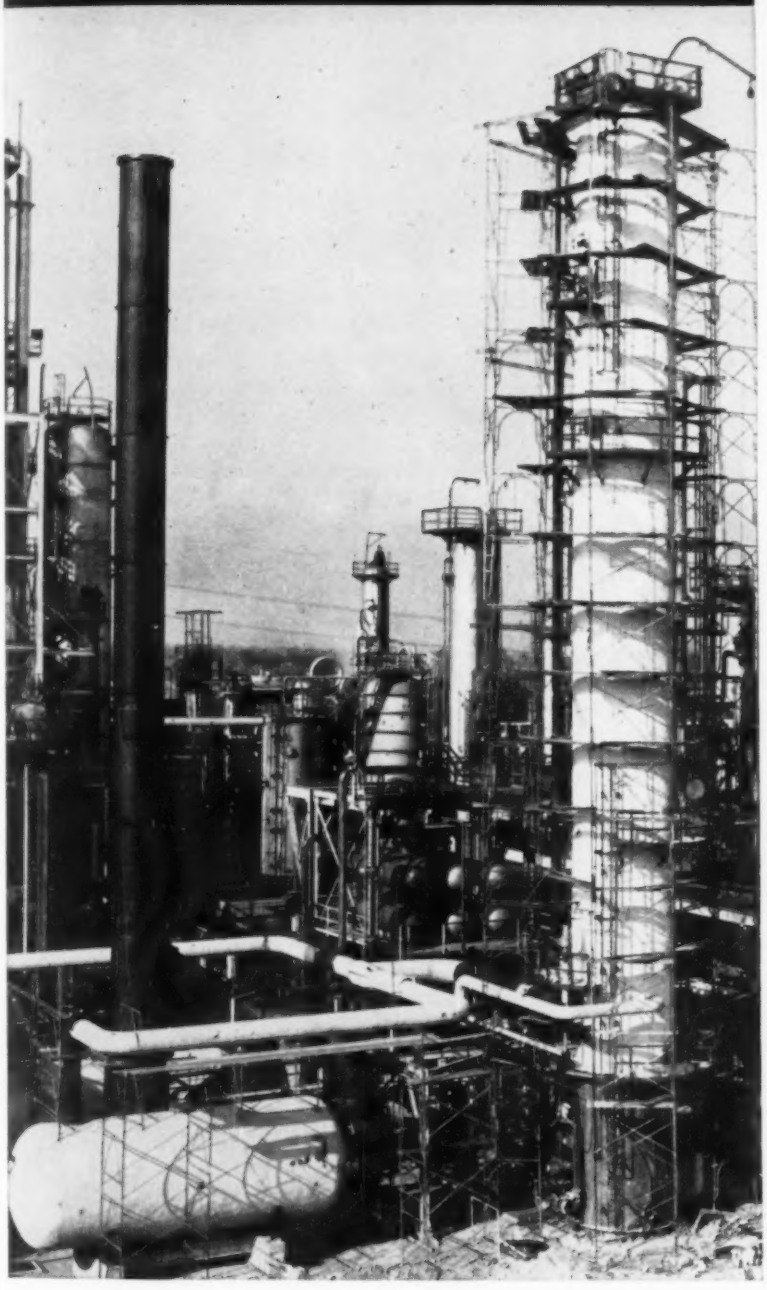
On Country's First REXFORMER® at AURORA REFINERY...



time saved by quick setting of

BALDWIN-HILL SUPER POWERHOUSE Insulating-Finishing CEMENT

B-H SUPER POWERHOUSE CEMENT, combining insulation value with a glazed white finish, was selected instead of a straight insulating cement because of its quick setting ability and good water resistance prior to weather coating. Rain, sleet or snow does not adversely affect the cement after setting. Its application speeds work—allows other operations to proceed with little delay.

SUPER POWERHOUSE CEMENT is a dry, fibrous material having a spun mineral wool base and a fast, hydraulic setting binder. It remains workable for two hours and then takes a hydraulic set in four to five hours.

SUPER POWERHOUSE was applied directly to the rib lath on the B-H spun mineral wool BLANKETS.

See our catalog in Sweet's Plant Engineering File.

BALDWIN-HILL COMPANY

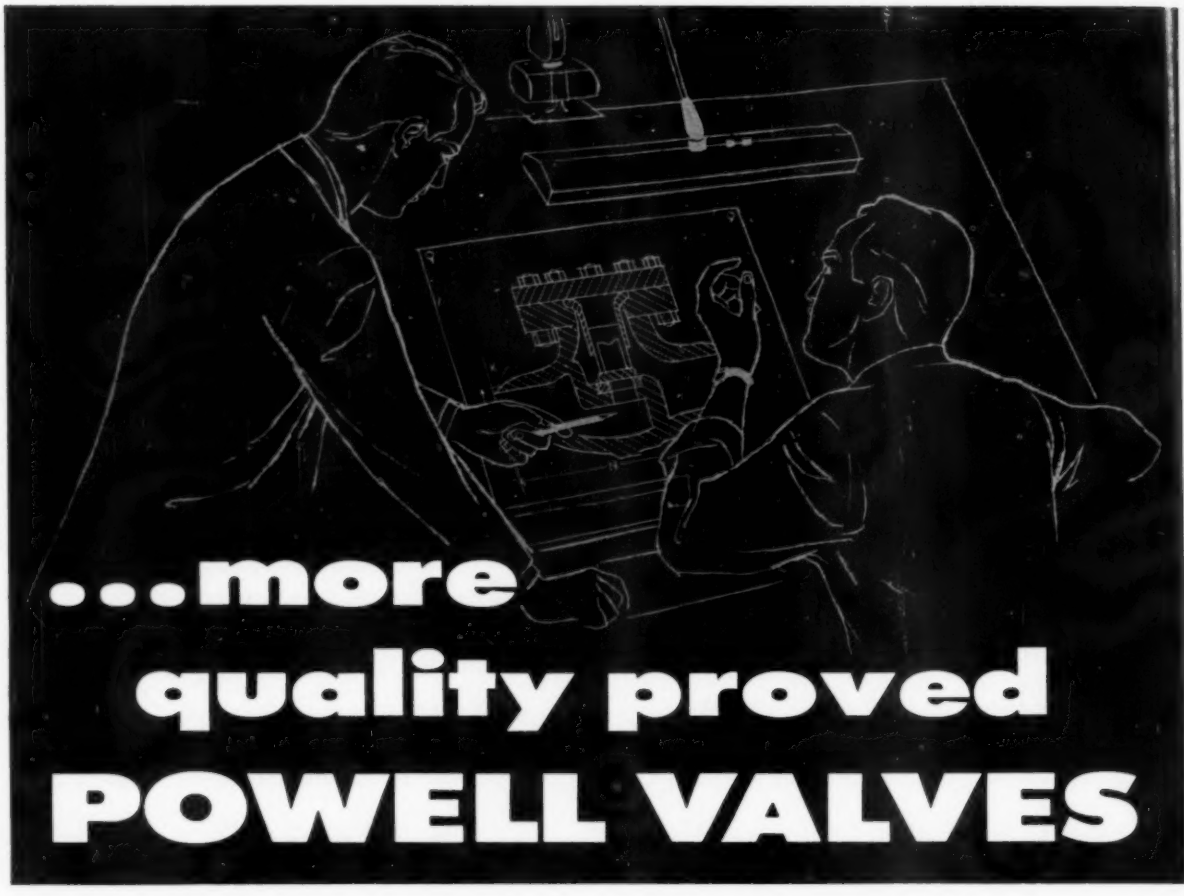
Complete Line of Industrial Insulations

1606 Breunig Avenue Trenton 2, N. J.

Huntington, Ind. Kalamazoo, Mich. Temple, Texas

For more information, staple the keyed corner of this ad to your letterhead and mail.

J-33



...more quality proved POWELL VALVES

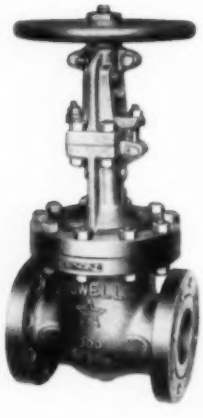


FIG. 3003—Steel Gate Valve for 300 Pounds W.S.P.

FIG. 1559—Steel Lubricated Plug Valve, ASA 150 Pounds, Screwed Gland Type, 1" to 4", inclusive.

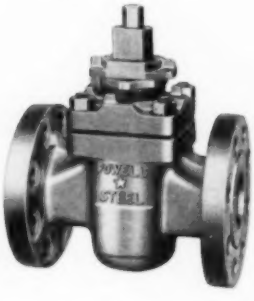
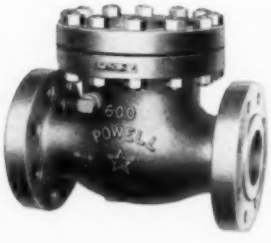
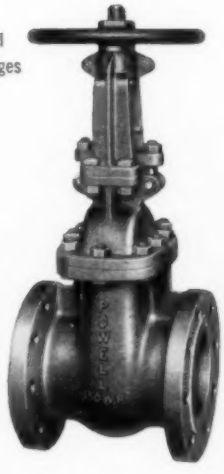


FIG. 2456 SG—Large Stainless Steel Gate Valve for 150 Pounds W.P. Flanges conform to latest Standards.

FIG. 6061—600-Pound Steel Swing Check Valve.





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Get the complete story of Zallea Expansion Joints in our new 72-page manual. Write, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 822 Locust Street, Wilmington 99, Delaware.

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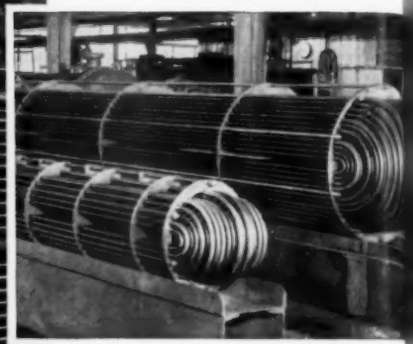
World's largest manufacturer of expansion joints

24" dia. Zallea Universal Self Equalizing Expansion Joints in service lines of the engine test facility of a West Coast aircraft manufacturer.

SMOOTH BENDS and



DUCTILITY PAYS OFF in trouble- and wrinkle-free bends. Republic ELECTRUNITE Heat Exchanger Tubing goes in easily. There are fewer maintenance problems because tube effectively resists installation damage.

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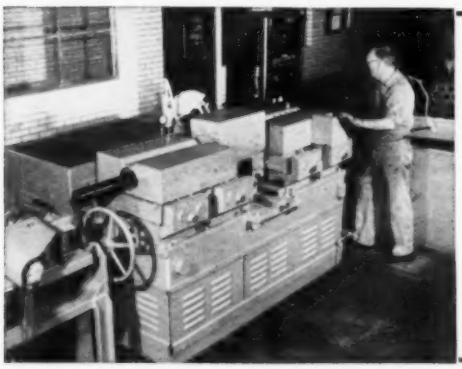

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World's Widest Range of Standard Steels

(To obtain more data on advertised products see page 158)

UNIFORM EXPANSION

Prove High Ductility of Republic ELECTRUNITE Heat Exchanger Tubes

User experience is best proof of the high ductility of ELECTRUNITE® Heat Exchanger Tubes. All reports tell of easier installations—smooth bends and uniform expansion. The reason is Republic's complete manufacturing control.

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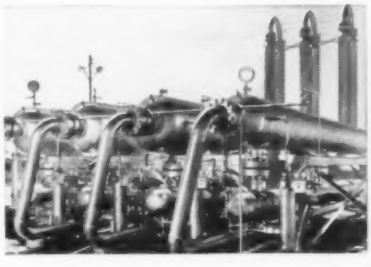

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(To obtain more data on advertised products see page 158)

Stainless transfer lines last three times as long as carbon steel —*still no sign of corrosion*

The picture shows the Pure Oil Company Smith's Bluff Refinery at Nederland, Texas. The two-stage distillation unit contains both atmospheric and vacuum furnaces, and both of them used to have carbon steel transfer lines. They lasted an average of 1½ years.

About four years ago, they replaced the lines with Type 304 Stainless Steel lines, in an effort to lick high temperature sulfur and chloride corrosion. The project was a complete success because, after four years, there is still *no* sign of corrosion.

In high-production, modern refineries like this one, there are very few investments that will pay off as well as Stainless Steel. Naturally, you get your greatest return when you design with Stainless from the very beginning. And you get the assurance of service-tested quality when you design with *USS* Stainless Steel.

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UNITED STATES STEEL

Are YOU Looking for a BETTER Job?

Petroleum Processing is again expanding its editorial staff, and its editors are looking for a man with technical training to fill the opening of assistant editor.

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Here are the specifications:

Education: If you are the man we want, you're a graduate engineer, with a B.S. in chemical engineering or industrial engineering, with perhaps a few extra courses in business or economics. You were in the top third of your class scholastically.

Industry Experience: You have had some practical experience (although maybe only a few years) in our industry. You are now employed by an engineering firm, or in the engineering department of a petroleum or chemical company, and associated in some technical capacity with petroleum refining, petrochemical manufacturing, or natural gasoline recovery. You know the kind of engineers who read Petroleum Processing, and the kind of problems they are up against.

Writing Experience: You have probably never thought of editorial work as a career, but you've been writing reports in connection with your work and found satisfaction in putting information down on paper in a clear, logical, organized manner. You may have done some writing as a hobby, or even have worked on a high school, college or similar paper or magazine. You can express yourself well.

Personality: You are curious about "why" and "how" things work, and you have the ability to explain their workings to others. You are able to organize your own work, and you have initiative to push ahead and get things done. You like meeting people and talking with them, yet at the same time you are a good listener. You are not a "glad-hander."

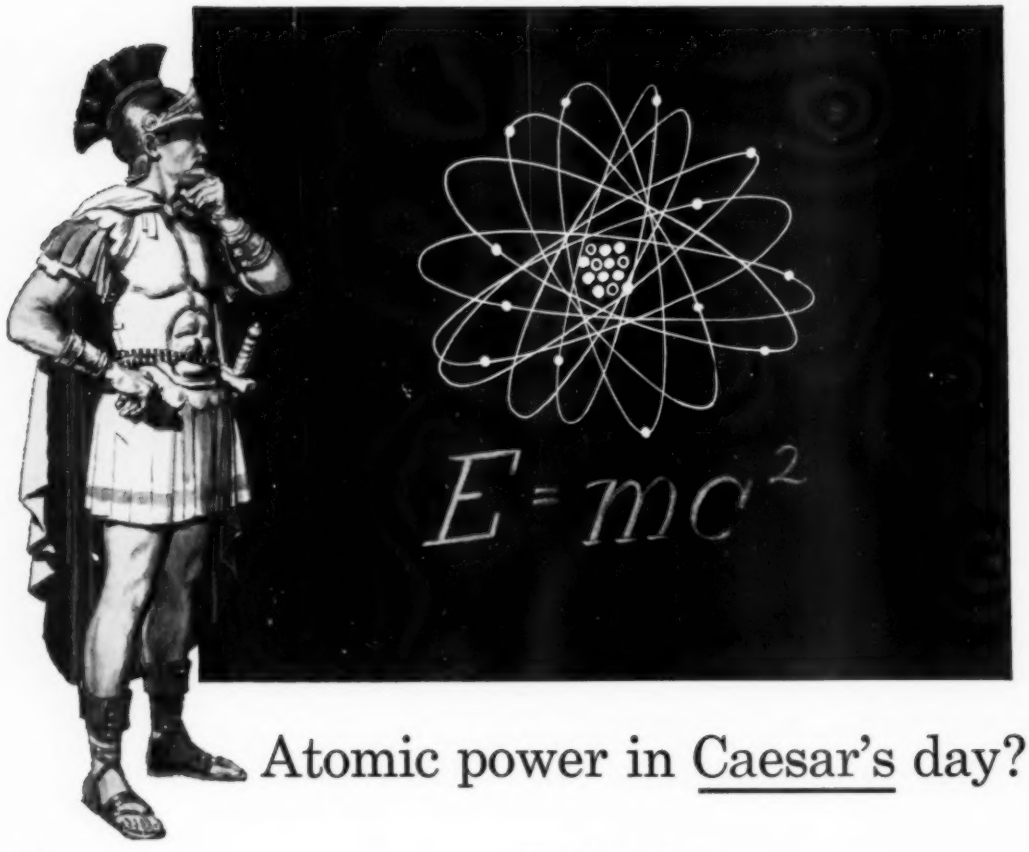
Location and Duties: You would welcome the chance to work in New York City, and you don't mind sitting behind a desk for a while, editing and rewriting other people's copy. Later (just as fast as you learn the ropes) you expect that you'll be given field assignments to gather data and write original articles.

Salary: You are now earning a respectable salary, and the chances are that this position will pay you even more right now—besides offering you the opportunity to rise more rapidly than you now expect to.

• If you think you are the man we want, send details on your background and experience (including salary history) to

William F. Bland, Editor
Petroleum Processing
330 West 42nd Street
New York 36, N. Y.

• If we think you are a qualified candidate, we will make arrangements for a personal interview. All replies will be held in the strictest confidence.



Atomic power in Caesar's day?

Certainly!

It was there, in the ground, in the air and water. It always had been. There are no more "raw materials" today than there were when Rome ruled the world.

The only thing new is knowledge . . . knowledge of how to get at and rearrange raw materials. Every invention of modern times was "available" to Rameses, Caesar, Charlemagne.

In this sense, then, we have available *today* in existing raw materials the inventions that can make our lives longer, happier, and inconceivably easier. We need only *knowledge* to bring them into reality.

Could there possibly be a better argument for the strengthening of our *sources* of knowledge—our colleges and universities? Can we possibly deny that the welfare, progress—indeed the very *fate*—of our nation depends on the quality of knowledge generated and transmitted by these institutions of higher learning?

It is almost unbelievable that a society such as ours, which has profited so vastly from an accelerated accumulation of knowledge, should allow anything to threaten the wellsprings of our learning.

Yet this is the case

The crisis that confronts our colleges today threatens to weaken seriously their ability to produce the kind of graduates who can assimilate and carry forward our rich heritage of learning.

The crisis is composed of several elements: a salary scale that is driving away from teaching the kind of mind *most qualified* to teach; overcrowded classrooms; and a mounting pressure for enrollment that will *double* by 1967.

In a very real sense our personal and national progress depends on our colleges. They *must* have our aid.

Help the colleges or universities of your choice. Help them plan for stronger faculties and expansion. The returns will be greater than you think.

If you want to know what the college crisis means to you, write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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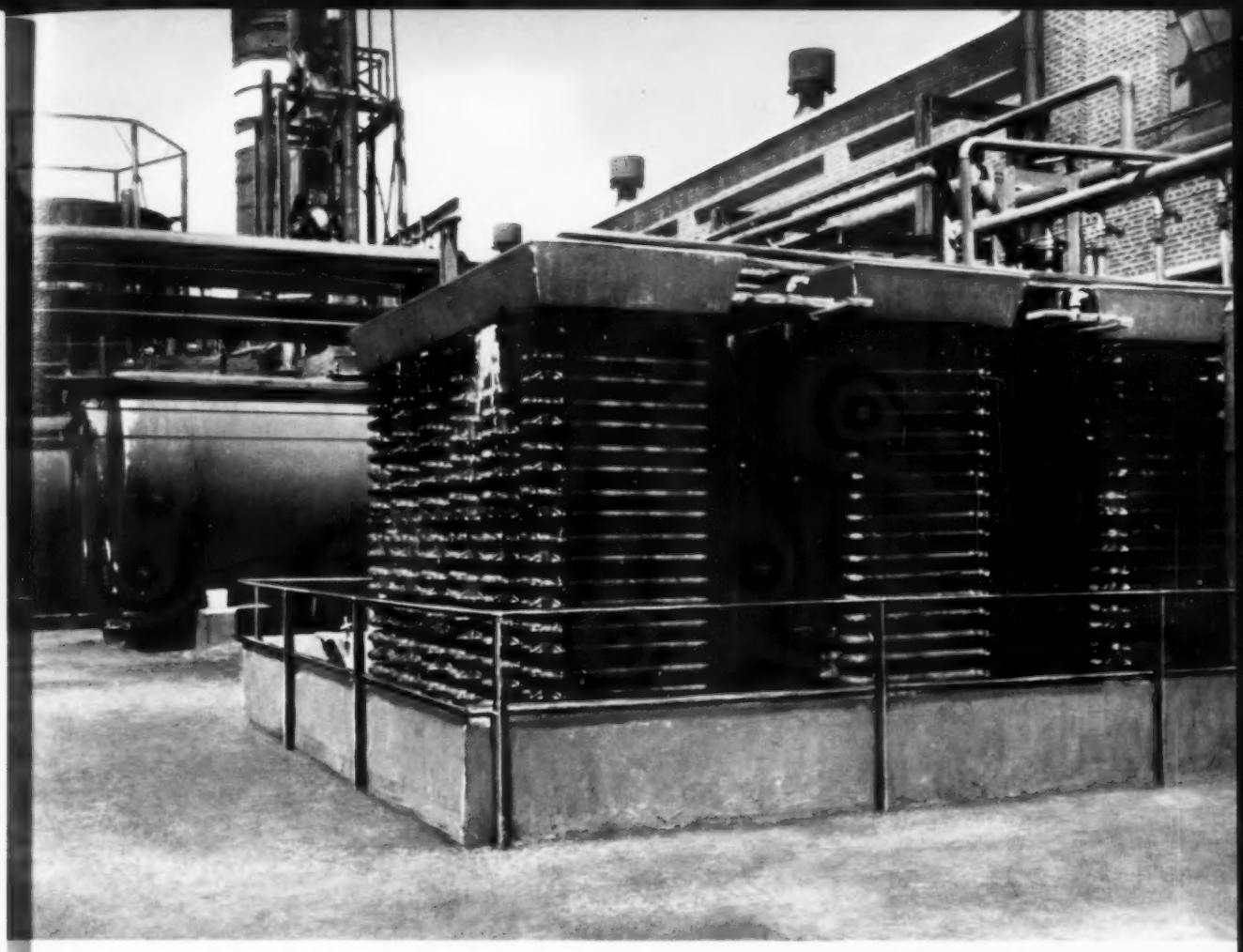
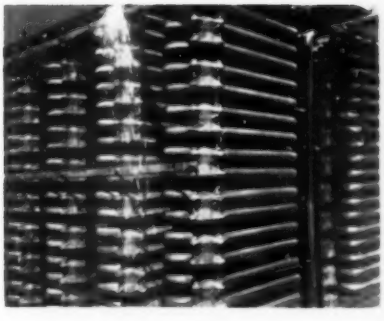


NALCO blue

that signals CORROSION PREVENTION



Nalco blue on these exposed cooling unit coils is the visible evidence of effective corrosion prevention at work. Nalco System chemicals used in this installation form a tough protective film of characteristic blue color on all ferrous metal surfaces. The metal is literally sealed off from direct contact with water, air and fumes, yet the film itself will not impair heat transfer efficiency.

Similar Nalco protection for your plant can cut maintenance costs and protect you against unscheduled shutdowns that are frequently caused by damaging corrosion. Call your Nalco Representative for some facts and figures on Nalco System protection and economy.

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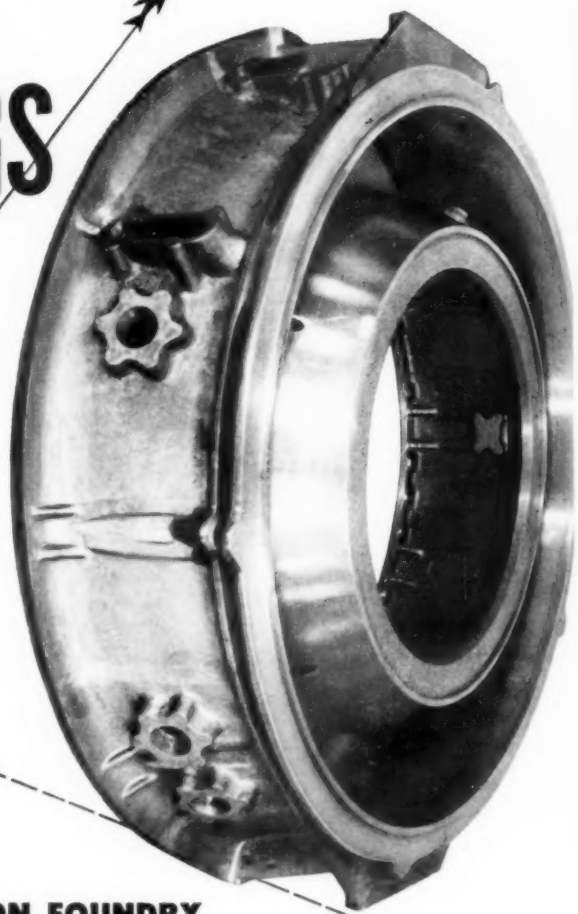
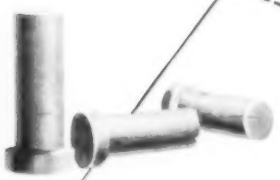
THE *Nalco*® SYSTEM . . . *Serving Industry through Practical Applied Science*

AIRCRAFT QUALITY

ALLOY CASTINGS

...for the special requirements of your industry





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handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

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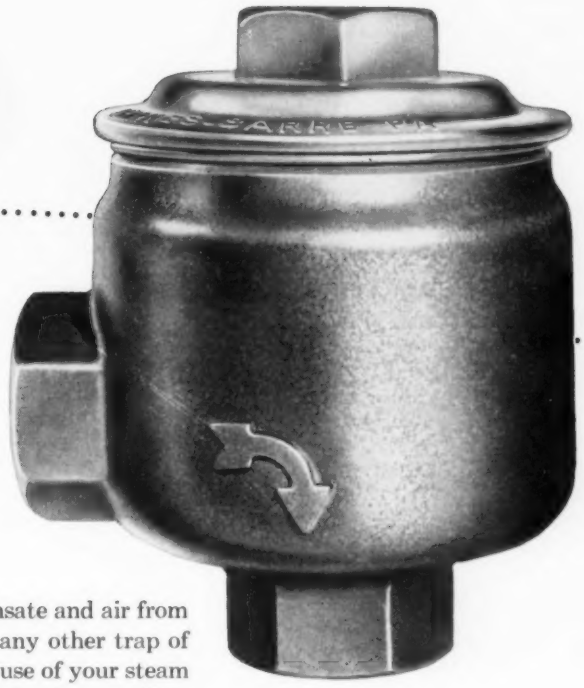
stop condensate backup



Nicholson steam traps discharge condensate and air from steam lines and equipment *faster* than any other trap of comparable size . . . help you make full use of your steam dollar. The reason—the effective use of a large orifice. A ½" Nicholson trap has a greater discharge capacity than most 1¼" traps . . . and costs less, too!

And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

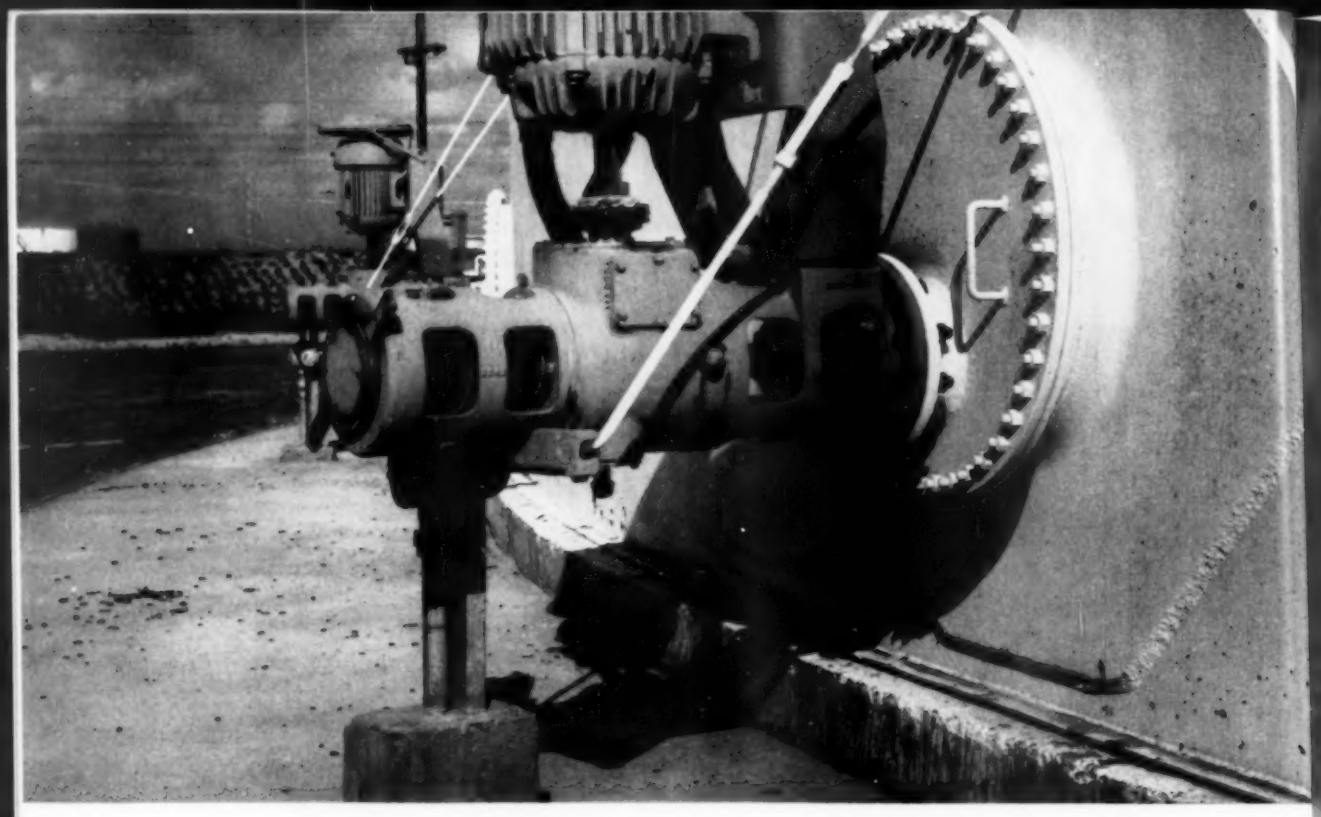
- **powerful valve action . . . no mechanical linkages to cause trouble.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that discharges faster, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055

NICHOLSON
of Wilkes-Barre

(To obtain more data on advertised products see page 158)



No repacking . . . no drip, drip, drip!

How Sinclair stops leakage, saves work

blending 150,000 bbl. of product in 6 hours

You can see, in this unretouched picture, how clean and safe Sinclair Refining Company keeps this product-blending operation, with the help of LIGHTNIN Mixers.

Tanks like this at Sinclair's Houston refinery hold 150,000 bbl. of finished gasoline. LIGHTNIN Mixers, three to a tank, blend the gasoline to full uniformity in just six hours. Not a drop gets through the LIGHTNIN rotary shaft seals!

Never need repacking

Even more significant is the saving—in time and maintenance cost—that Sinclair makes with mechanical seal-equipped LIGHTNINS. They *never* need to be repacked, *never* need shaft seal adjustment!

These LIGHTNINS have been in operation one year. "Maintenance requirements? Negligible!" say Sinclair's refining people.

You can save as much as 60% on big tank mixer maintenance with this newest LIGHTNIN feature. Year after year, you get dependable sealing, end stuffing-box repacking and adjustment for good.

Fast, easy replacement

And for the first time ever on side entering mixers, you can replace this seal *in a jiffy* if you ever have to!

Even under a full head of liquid in the tank, the seal-change job takes only minutes. No need to dismantle or remove the mixer from the tank. No special skill needed, either—it's a one-man, one-wrench job!

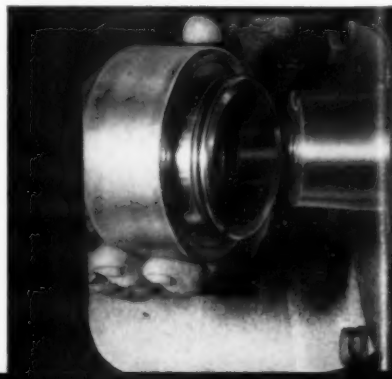
Available on all LIGHTNIN Side Entering Mixers, the LIGHTNIN seal cartridge is a unit assembly, easy to stock as a replacement or quickly obtainable in all sizes and materials for the simplest or toughest mixing conditions.

How much can *you* save? Your LIGHTNIN Mixer representative can give you the full story. Call him today—he's listed in Refinery Catalog. Or send the coupon for 8-page illustrated bulletin on LIGHTNIN seals and catalog information on LIGHTNIN Mixers.

Lightnin® Mixers

MIXCO fluid mixing specialists

SEAL SLIDES OFF mixer shaft, which uncouples to permit removal. New cartridge slides on. Taper on shaft insures correct realignment. Seal replacement is a fast, simple, one-man job.



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Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 131-f Mt. Read Blvd., Rochester 11, N.Y.

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The Asphalt Debate Is On

Here's how oil and highway officials stand on grading, handling changes

ASPHALT COMPANIES and highway officials now fully recognize three goals. These must be met for asphalt to share fully in the coming $50-billion nation-wide highway program. The greatest asphalt demand is still for road building and maintenance.

The three goals, set forth by PETROLEUM PROCESSING in January, are:

1—Recognize standard specifications.
2—Eliminate duplicate inspections.
3—Simplify inspection procedures.

In comments to PETROLEUM PROCESSING since January, spokesmen for the asphalt manufacturers, state highway departments and the Asphalt Institute have argued the merits of the three points and how they may be achieved.

On Point 1, general acceptance of standard specifications, some states still maintain their own "specs," insisting that road building and maintenance within their boundaries calls for material of particular properties. That standard grades will meet all needs and lower the cost of asphalt is maintained by the Asphalt Institute, whose members are most of the oil companies manufacturing asphalt. The Institute in recent years has reduced the number of grades for which it issues specifications without, it is claimed, affecting the actual requirements for asphalt materials in any areas or type of road building.

Point 2 takes the position that, where qualified state inspectors test an asphalt product at the refinery, particularly where the tanks are pretested and sealed and shipment is in sealed tank cars, a second inspection by the state agency at the point of use is unnecessary. Because the refinery makes its own tests and furnishes samples of analyses to users, some authorities contend the inspection by the state agency at the refinery is not needed. The duplicate testing is costly and sometimes a bottleneck.

Where the state has its own specifications, the highway officials there claim they must test shipments regardless of earlier inspections, to make sure the material meets their own individual requirements. A few state officials state that the check at the point of use must be made to insure there has been no contamination.

The principal method by which inspection procedures in general could be simplified, Goal 3, would be through doing away with the "batch" system of manufacture and inspection. Many states now require that the refiner make up an order of asphalt to specifications, and seal it in a storage tank after it has been tested. It can then be withdrawn without further inspection.

Batch manufacturing prevents the refiner from adopting continuous operation through blending as material is ordered out, and it unnecessarily ties up storage tanks. As with other refinery products, occasional in-line sampling and testing would show if the finished material was up to specification. Occasional sampling could also be done at the point of delivery, but in the main, both manufacturing and delivery operations would be speeded up.

To reach these goals the oil industry must take the lead. It should work in coordination with the Asphalt Institute to educate and influence state highway officials to change procedures. The oil companies agreed to this requirement, which was also urged by PETROLEUM PROCESSING in January.

The oil industry also sees a need for a wide educational program to present to the public the advantages of asphalt in road building. Only through such a program can the oil industry hope to achieve the 100 to 110-million bbl market for asphalt in road construction that some highway authorities forecast as possible by 1960, double today's flow of asphalt to this market.

Highway officials in 20 states made pertinent comments on the conditions now affecting the use of asphalt in highway construction. All parts of the country were represented.

Comments on factors affecting the selection and handling of asphalt were received from 12 oil companies that manufacture asphalt. Excerpts from all these letters follow, arranged according to their relationship to the goals brought out.

The debate began in January

The article, "Surge Ahead for Asphalt," p. 39, January, 1957, PETROLEUM PROCESSING, pointed out the demand for this product that the huge road building program can create, and brought out some inspection and other hurdles to be overcome if asphalt is to take its full part in the program.

"For Better Asphalts Try Continuous Automatic Blending," p. 41, showed how manufacturing techniques could be improved.

The Editorial, "Is Asphalt Losing by Default?" p. 166, pointed up the three goals the oil industry must achieve to make the most of the market for asphalt that the highway construction program will create.

Readers desiring extra copies of these articles may have reprints by writing the Editor of PETROLEUM PROCESSING in New York.

Asphalt goals now set . . .

1—Standard nation-wide specifications

FOR

As might be expected, the oil companies are almost unanimously in favor of the adoption and use in all states of the standard specifications of the Asphalt Institute. Some feel that, while standard grades are desirable in place of state "specs," more research is required before they can be fully promulgated. In some instances, the state highway departments support standard specifications and even a smaller number of grades than are now set up.

Glenn E. Nielson, president, Husky Oil Co., Cody, Wyo., Chairman of the permanent Asphalt Committee of the American Petroleum Institute

"Over the years the states have built up their own specifications. In fact, sometimes through political influence, specifications have been set up designed primarily to eliminate all asphalts except those from a particular area. Other specifications, of course, are an honest attempt to determine quality.

"It is a slow uphill process to have uniform specifications adopted. We ship asphalt to some 12 or 14 different states and consequently are particularly aware of the variety of specifications. The confusion naturally is expensive. The net result is that the taxpayers of the country are paying for the multiplicity of grades."

Harold L. Plummer, chairman, State Highway Commission of Wisconsin

"We agree that some further reduction can be made in the number of grades of liquid and solid asphaltic materials without materially affecting the ultimate pavement quality. In the liquid asphalts grades, 0 and 1 and 3 and 4 could be combined in two median viscosity grades and Grade 2 possibly omitted entirely. In the asphalt cements three or four grades could be standardized with a skip in consistency between grades, or a broadening of consistency limits permitted under the specifications for the new grades to include all of the old."

R. Linden, vice president-marketing, Union Oil Co. of California

"The reduction in the number of recommended grades of asphalt cement from 9 to 5 has been praised by several state highway departments in the west. They recognize that too many grades can cause confusion and uncertainties in designing a pavement and that the reduction in the number of grades in no way lessens the quality of the highways.

"The two principal things that can be done to increase confidence in the use of asphalt and improve the petroleum industry's position in the Interstate Highway Program are 1—develop and adopt new asphalt specifications that will help to define quality, 2—develop new or improved engineering construction methods to eliminate pavement failures."

T. E. Fitzgerald, executive vice president, Marketing, D-X Sunray Oil Co.

"Last December, in New York, the asphalt refiners voted in line with the recommendation of the special committee of the Asphalt Institute to reduce the grades of asphalt cements from 9 to 4 grades, thereby eliminating 5 of the 9 penetration grades. Mr. A. C. Clark, Deputy Commissioner of the Bureau of Public Roads, has approved this step. We also have a committee working on a reduction in the number of grades of rapid curing, medium curing, and slow cutting asphalts. I am sure a sizeable reduction will be made in the number of grades of each at our next Asphalt Institute meeting."

Stanley S. Scarborough, testing engineer, Delaware State Highway Department

"Our Highway Department, through trial and error methods, has arrived at what we think is the most practical general policy on specifications for asphalts. 1—we have standardized on one grade of asphalt cement, 70-85 penetration, on 99% of our work. 2—on cut-back asphalts, we specify only two grades, RC-1 and RC-3. 3—our state is undertaking a large program of surface treating of over 2000 miles of existing "dirt" roads. About 75% of these roads will be stabilized with one type of inverted emulsified asphalt. In other words, in 99% of our construction we will use only 4 types."

AGAINST

State highway officials generally take the position that, at the present time, universal adoption of standard specifications for asphalts would not be practical. Experience of many years in individual states in road building and maintenance has led to setting up standards to meet particular soil and climatic conditions there. Others feel that the present standard specifications allow too wide a latitude in properties of the material and the property limitations should be more closely defined to meet the needs of individual states. Some state officials feel the oil companies have not done enough field work in the highway use of asphalt to promulgate overall standard specifications.

A. W. Eatman, materials and tests engineer, Texas Highway Department

"Our specifications show a total of 22 separate grades of asphaltic materials for the requirements in our state. However, last year we used only 16 of these grades and some of these in negligible quantities. Use of an improper grade can definitely lead to unsatisfactory performance, reduced life of the pavement and greatly increased maintenance. The wide variety of soil and climatic conditions in Texas calls for different grades and practices.

"One need only look at the widely different types of

highway uses for which we depend on asphalt to see the necessity for a considerable number of grades here. For example, we have primes, membranes, crack sealers, single and multiple surface treatments, road mixes, dust palliatives, hot and cold mixes and other miscellaneous uses. We expect satisfactory performance during the heat of summer and the cold of winter. It would seem advisable to caution against any premature reduction in the number of grades whereby the quality of the finished highway might suffer."

R. I. Rowell, materials engineer, Vermont Department of Highways

"The problem of simplifications of grades of asphalt has been discussed by a good many states and appears to be a difficult one to cope with because different soil conditions require different grades of material. This appears to be particularly so in the maintenance field. Some New England states use grades of bituminous material that neighboring states do not use at all."

G. L. Oliensis, director of research, Lloyd A. Fry Roofing Co., Chicago

"The basic reasons why standard specifications have not been universally adopted are:

1—unlike such structural materials as steel, brick, Portland Cement, etc., two asphalts may meet a standard specification equally well but nevertheless differ materially in character and quality; 2—all asphalts, good, bad and indifferent, are black, look alike, and are stored and transported as liquids. Hence they can be readily (and not necessarily intentionally) adulterated with asphalts of inferior, or at least different, types without the likelihood of prompt detection."

G. T. McCoy, state highway engineer, California Department of Public Works

"The present asphalt Institute specifications will permit acceptance of material having a wide spread in engineering properties. This is especially true when asphalts are manufactured by different methods and from various crude sources. This disparity between test values and performance has lead to certain changes on our requirements for paving asphalts. We consider these requirements to be tentative and we expect that further changes will be necessary as new test methods are developed to insure asphalts of better quality.

"In the accelerated highway program there is the natural tendency to simplify and standardize on all specifications for engineering materials. We are in full agreement with this principle. However, if such standardization means 'freezing' the current requirements, it will seriously hinder future developments leading to improvements and better materials of construction."

Paul S. Otis, materials & research engineer, New Hampshire Department of Public Works and Highways

"Variations in individual state specifications may require additional tank capacity for the same grade of material. New Hampshire's specifications for rapid-curing asphalt are the same as New York's but vary considerably from Massachusetts, Maine and Vermont. In this case the refinery meets our more rigid specifications and sells all purchasers of this grade."

2—Eliminate duplicate inspections

FOR

Both the old companies and state officials recognize the benefits and savings through reducing the number of inspections of asphalt materials required, particularly in eliminating inspections at the point of use as well as the refinery. One practical suggestion in this direction is for the state officials in a given area to place all this work in the hands of one outside inspection agency, whose responsibility it would be to sample and test only as needed.

T. E. Fitzgerald, executive vice president, Marketing, D-X Sunray Oil Co.

"The efforts of the Asphalt Institute and the manufacturers of asphaltic road materials toward getting the states to accept specifications materials approved in the state of origin without further inspection have been of no avail.

"Many of the states require the testing to be done by an outside independent laboratory. The usual price for testing asphalt is $20. The Northeast Oklahoma Turnpike, for example, would not accept materials tested by the Oklahoma State Highway Department but made a contract with a testing laboratory, at a price of $17.50 per sample. The Turnpike Authority requires that a sample be taken from each truck loaded and the truck sealed at the refinery. You can see what a tremendous additional amount of money is being spent to build the Northeast Oklahoma Turnpike when the testing cost alone of each truck load of asphalt going on the turnpike is $17.50."

W. G. O'Harra, engineer of materials, Arizona Highway Department

"We have simplified our inspection procedures so that a minimum of inconvenience and delay results for the refiner and the contractor. We require that each refinery furnish us with a certificate giving the test results on each shipment. Upon arrival on the job, the shipment is sampled but the material is released for use on the basis of the certificate. The sample is submitted to the central laboratory for testing. As long as the material complies with specifications, this arrangement with the refinery is continued."

Charles M. Ziegler, Michigan State Highway Commissioner

"We retain the Chicago Testing Laboratory to obtain samples of all shipments of asphaltic materials to Michigan state highway projects from all refineries. These samples are sent to the Michigan State Highway Laboratory at Ann Arbor for sampling. The refinery has the option of holding the shipment until notified of the results of the tests on sample or shipping on its own responsibility. In most cases, the laboratory is able to report the test results to the field before the tank car arrives. With truck shipments, withdrawals from tested storage tanks are made only in the presence of our samplers and only for highway projects. Releases for

each shipment are delivered to the project by the tank truck driver; copies are sent to the laboratory where the inventories of tested stock are kept."

W. N. Lovejoy, bituminous engineer, South Dakota Department of Highways

"We do not send a representative to the refineries that supply us, nor do we hold up use of the material pending testing. We require refinery samples and analyses that we compare with our own field tests. As long as these are in agreement there is no difficulty. We have not had a car of material rejected in 3 or 4 years. However, we feel that we have to have these checks because there are companies that would take advantage of us as long as we award business to the low bidder."

Harold L. Plummer, chairman, Wisconsin Highway Commission

"It is our belief that testing and evaluation of materials at the point of origin by a single agency such as the local highway department would result in considerable savings in time and cost. Additional tests would still be required in some cases to cover differing state specifications."

S. O. Linzell, director, Ohio Department of Highways

"Our department maintains inspection at all bituminous material refineries in or adjacent to Ohio. Tanks of bituminous material are sampled by our inspectors who send the samples to our laboratory for testing. The inspector also makes certain that material shipped to a project is loaded from tanks that have been tested. In emergencies, where the manufacturing source has a satisfactory record with our department, shipments of sampled stock are permitted on the basis of the producer's test results, subject to confirmation in our laboratory. Tank car samples from refineries well outside our state boundaries are submitted to our laboratory by an independent sampling service. Infrequent receipts from distant sources will usually be sampled on delivery."

AGAINST Eliminate duplicate inspections

J. E. Ward, chief paving engineer, Barber-Greene Co., Aurora, Ill.

"I can see quite a serious problem in the elimination of duplicate inspections. In general, because of storage, handling and transportation problems, materials, unless carefully controlled may be blended or fouled up even though satisfactory at the refinery. Generally, there would be no difficulties, but I doubt that the state highway departments would waive the right to reject unsuitable materials on the job regardless of the cause of their inferiority."

Newman E. Argraves, Connecticut State Highway Commmissioner

"I do not believe it is possible to get the states to accept specification material approved in the state of origin without further inspection. For several years now we have been trying to get the New England states to adopt the same cutback material used in Connecticut —using the odd numbers for medium curing cutbacks and the even numbers for rapid curing cutbacks. However, we have not been able to accomplish even this minor change. If this could not be accomplished it would be impossible to have the states accept material approved in another state. Another obstacle is that all states do not have the same specifications."

L. F. Erickson, materials engineer, Idaho Department of Highways

"This state has been sampling asphalts on delivery to the project for the past 20 years and longer, since we receive these materials from as many as 12 different suppliers located in 5 states. We have endeavored to make arrangements for inspection at the source, but without success. The cost of hiring commercial laboratories to do this work for us is prohibitive. Sampling materials at delivery has worked out very well for us. In the past 4 years failures of shipment to meet specifications has not exceeded 3% and nearly all of these were minor, in consistency or viscosity."

Paul S. Otis, materials and research engineer, New Hampshire Department of Public Works and Highways

"The point is often missed in discussions on inspections that, while the material in storage at the refinery may meet the specifications 100%, someone may become confused and ship material from the wrong tank. This error may be difficult to detect before the asphalt has been spread. This is the main reason for pre-testing. The same argument holds true when using a continuous blender. The operator may be blending fuel oil with asphalt by mistake when the order calls for rapid curing cut-back."

3—Simplified inspection methods will save time and money

In addition to eliminating duplicate inspection of asphaltic materials going to highway construction jobs, many state officials believe that general inspection procedures can be simplified. This would reduce this item of cost, because sampling and testing runs up to $20 per sample where an outside agency is used, and it would also permit the refiner to improve his methods of manufacturing and storing asphalts, including in some cases automatic blending.

E. A. Rosenstone, director, Illinois Department of Public Works and Buildings

"We have had some experience with continuous blending on the basis of tests made on the base stocks and diluents. We sample and test the finished product from the blenders before approving it. When these automatic blenders are improved and become more generally used, we may be able to set up standards for these units and

approve for direct loading the installations that comply with the required standards."

J. E. Ward, chief paving engineer, Barber-Greene Co., Aurora, Ill.

"Certainly it seems that we should be able to take advantage of the economics of mass inspection and testing. The manufacture of cut-backs from a base stock by blending at time of shipment seems to make good sense. I do not know whether engineers would approve the material based solely on the efficiency and integrity of the supplier. I am afraid that this will require a lot of promotion and education and it will of necessity require consideration not only of ease and simplicity of production and also in establishing confidence in material quality."

V. M. Daggett, chief engineer, Maine State Highway Commission

"It appears to us that a simplification of procedures or reduction in the number of grades of certain material would be desirable; however, such a move should certainly be instigated by the industry and not by the individual state highway departments."

T. V. Fahnestock, bituminous engineer, N. Carolina State Highway and Public Works Commission

"In regard to inspecting and testing of asphaltic materials, it seems that it would be possible to work out a system that would simplify the methods presently used by most state highway departments, which would result in savings to producer and buyer."

A. W. Eatman, materials and test engineer, Texas Highway Department

"We have found asphalt producers to be very cooperative in furnishing any grades or meeting any specification material for which we had a reasonable amount of information showing its justification. We might also point out, and we feel most producers will agree with us, that a properly handled inspection setup is of considerable advantage not only to the highway department but also to the producer and the contractor."

And a fourth goal: oil companies must lead

The refiners making asphalt believe they could do more research in the use of this product in road building, even to doing field work with their own engineers in highway construction to determine what materials are best suited for this use. They are also convinced the entire oil industry should do more to promote this use of asphalt and to educate the public in their belief that the oil companies, at least to the present, have regarded asphalt as a by-product and have neglected working with the state highway engineers to improve their product specification and their methods for testing and handling asphalt.

R. E. Britton, consulting engineer, Pennsylvania Slag Assn., Pittsburgh

"There are many state highway engineers who would welcome advice from the refinery engineers regarding the constituents of their products and what to expect from certain viscosities, penetrations and temperatures. And there are many refinery engineers who need to get out from behind their desks and move into the field to see how their product is being used or abused."

Glenn E. Nielson, president, Husky Oil Co., Cody, Wyo., Chairman American Petroleum Institute permanent Asphalt Committee

"We must agreee that the efforts of the industry do not compare with those of the Portland cement industry but, in looking back over the increasing tempo of publicity the past three years we are hopeful for the future. Through our API committee's recommendations, an active program of public relations and advertising was adopted last year and will be repeated this year, and, I hope, increased in future years. We held an intensive six-weeks seminar last summer at Purdue University, in which engineering professors from many different schools were enrolled. The course taught methods of handling asphalt from an engineering standpoint. We hope to hold a similar seminar this summer at the University of California."

C. C. Tate, manager, Refining Department, Phillips Petroleum Co., Bartlesville

"Simplified inspection procedures and a reduced number of grades are basic requirements to make more efficient blending processes possible. Improved service to customers, and improvements in economics for all agencies concerned could result from these measures.

"The Highway Research Board-Asphalt Institute Joint Committee on Asphalt Research may be the logical group to determine how much objectives could be achieved. Without the assistance and endorsement of a committee such as this, contacting the states individually could very possible result in confusion."

Robert E. Witt, manager, Asphalt Sales, Lion Oil Co., El Dorado, Ark.

"What is overlooked is that every petroleum processor, whether he manufactures asphalt or not, has a tremendous stake in the asphalt market. For each highway dollar more miles of high-type pavement can be built with the use of asphalt. These high-type pavements, of course, encourage automobile travel.

"In addition, the sale of any petroleum product strengthens the economy of the petroleum industry. I feel that if every producer of crude oil, every manufacturer of petroleum products, every person who receives a dividend check from an oil company or royalty from a producing well cooperated to promote asphalt, that product would no longer need apology or excuse."

G. W. McAlpin, asst. deputy chief engineer, New York Department of Public Works

"We attempt to work very closely with the asphalt industry. We do not feel that our procedures of inspection and control represent perfection and we are continually reviewing this subject toward the goal of improvement both for ourselves and future suppliers. In this regard we solicit assistance from the asphalt industry."

Table 1—Sulfur in 100 octane gasoline blending stocks

Stock	% of total US pool gasoline*	Can have sulfur in this % range	Can be these S compounds	Today's economics of removal	How to remove sulfur
High severity reformate	20.6	Less than 0.01	Thiophenic	Unfavorable	
Heavy cut reformate	—	Less than 0.02	Thiophenic	Unfavorable	
Solvent extracted reformate	—	Less than 0.01	Thiophenic	Unfavorable	
Polymer	4.0	0.03 to 0.10	Free sulfur Mercaptans Alkyl monosulfides and disulfides	Favorable	Remove last traces of H_2S, mercaptan and free sulfur from feedstock. Mercaptans occurring in polymer can be removed by caustic wash.
Alkylate (HF) Alkylate (H_2SO_4)	2.1	Less than 0.01** High as 0.10	Mercaptans Alkyl monosulfides and disulfides Organic sulfates Sulfones	Favorable to remove from feed, effluent and other points in system	Same as for polymer. In HF units, remove acid soluble oils. Considerable sulfur is removed by re-running. In H_2SO_4 units, effluent treating may be practiced.
C_5 and C_6 isomers, superfractionated crude fractions	—	Less than 0.01 to 0.05			
Catalytic isomers and fractions	—	Less than 0.01	Alkyl monosulfides	Favorable	Some units may be operated under desulfurizing conditions.
Full-boiling cat cracked gasoline	28.8	0.02 to 0.25	Alkyl and aryl mercaptans, monosulfides and disulfides Thiophenic	Favorable	Remove alkyl and aryl mercaptans by some variation of effective caustic washing. Sodium treating is a future possibility.
Light cut cat cracked gasoline	—	0.01 to 0.10		Depends on sulfur type	
Butanes	4.9	traces	H_2S Mercaptans Free sulfur	Favorable	Variations of caustic treating.

*Based upon 10 lb RVP stocks.
**Under normal operation.

What Sulfur Means to 100-Octane Fuels

By G. H. UNZELMAN,* Ethyl Corp.

WHATEVER route gasoline processing has taken in the past, a certain amount of sulfur has remained in the finished product. Fortunately, as refinery processing has advanced, the amount of sulfur in the finished product has continued to decrease. Unfortunately, the significance of this remaining amount of sulfur in highly refined gasolines has continued to increase.

This situation is a little difficult to put into focus when the average sulfur content of a present-day 100 octane gasoline is compared with that of premium fuel of a year ago.[23] In order to classify as high sulfur, the premium gasoline had a sulfur content of at least 0.08% or higher. Present refining methods however, have reduced sulfur level in 100-octane fuels, and many premium gasolines, to a much lower figure—about 0.04%.

*George Unzelman is a previous contributor to PETROLEUM PROCESSING. His biography can be found on p. 97 of the May issue.

Whether the economics of this, and even lower, sulfur levels should be re-appraised is based upon the individual gasoline pools, refining methods, location of market, etc. However, sulfur removal from high-octane fuels is still an important factor in octane improvement economics.

Several changes have taken place in the refining industry during the past eight months, and some of these have increased the cost of octane improvement. This article will discuss these changes with respect to the octane improvement possible with further desulfurization of high octane blending stocks.

In a section of a recent publication, [20] the economics of sulfur were appraised from the standpoint of sulfur in U.S. pool gasoline. This was further related to sulfur in the individual refinery pool. Economics were based upon the U. S. gasoline pool of 1955 and tetraethyl lead (TEL) costs for octane improvement. This economic approach may still be applied to most of the gasoline blended in the U.S. today. But many new factors are involved in the study of sulfur economics of the 100 octane fuels and many high octane premium fuels:

- Sulfur consideration is no longer entirely limited to processors of high sulfur crudes.
- Octane improvement economics are such that maximum TEL is used in blending 100 octane gasolines.
- Octane improvement costs skyrocket in the 100 octane range.
- Motor octane number as well as Research octane number has become a control specification in blending 100 octane fuels in many instances.
- Refinery practices for raising octane number tend to lower the sulfur content of 100 octane blending stock.
- New processes have been developed that can lower still further the sulfur content of high octane blending stock.
- The blending of a super premium gasoline has effected a redistribution of sulfur to other gasoline grades.

In most instances where sulfur problems occur in the refining industry, those concerned are usually processing a high-sulfur or sour crude. However, when considering sulfur in high-octane gasoline, almost everyone should be involved, at least to the extent of completely evaluating his own situation. It is still true that the refiner processing high sulfur crude will have higher than normal sulfur content in his high octane gasolines. It is also true that this refiner is usually well aware of sulfur problems, and is more likely to be taking a calculated loss caused by sulfur in gasoline than is the refiner of low sulfur crudes.

Per cent sulfur in 100-octane gasoline

An appreciable octane loss in finished 100-octane gasolines may be incurred with any amount of sulfur—even concentrations as low as 0.01%. Today, it is generally accepted as impractical to consider the removal of such a sulfur concentration. However, if the octane loss from this small amount is recognized, it may be reduced by treating a particular component that has a higher sulfur content and is contributing to the 0.01% sulfur in the final blend. The recognition of the effect of even a small amount of sulfur will also encourage continued research toward a practical process for complete desulfurization, and an ultimate solution to the problem.

Investigation of the sulfur contents of presently marketed fuels of 99 RON and higher indicates an average sulfur content of close to 0.03%. Finished fuels having less than 0.01 or higher than 0.06% sulfur are almost nonexistent. There may be an occasional exception, of course. For example, a refiner forced to use a very severely reformed gasoline and butane in order to compound a 100-octane gasoline could market a fuel containing less than 0.01% sulfur. It is also possible that a refiner with limited treating facilities and a high sulfur crude might turn up with higher than 0.06% sulfur in a finished 100 octane gasoline.

Eliminating sulfur in 100-octane stocks

Reformed gasoline (catalytic): Catalytic reformate contains very little sulfur, and on this basis presents no problem as a blending stock. As reforming severities are increased, more of the cyclic sulfur compounds are broken down and converted to hydrogen sulfide and hydrocarbon. Thus, the higher the severity of reforming, the less sulfur in the finished stream. This is graphed in Fig. 1 [14].

The platinum-catalyst reformer is in itself a desulfurizer. However, as severity is increased, the bad effects of sulfur and other contaminants on the reforming catalyst are also increased. This has led to almost universal acceptance of hydrogen treating of reformer feed stocks in order to protect the platinum catalyst. The severity of hydrogen treating is generally based upon economic studies, and a balance is obtained between profitable desulfurization and the optimum amount of sulfur that should reach the reforming catalyst. In any case, the reformed product will rarely contain more than 0.01% sulfur if operation is directed toward producing 100-octane blending stocks. [2] [3] Even heavy reformates (front end removed) generally do not contain more than 0.01% sulfur even though cyclic sulfur compounds are more apt to be associated with the higher boiling aromatics.

Polymer gasoline: The sulfur content of polymer gasoline is a function of how efficiently the feed material to the unit is treated. Many polymerization units have been constructed in past years. As long as the poly effluent was sweet and corrosion or fouling problems were absent, the feed pretreatment was considered sufficient. Under these conditions the sulfur content of the poly gasoline could be as high as 0.10% depending upon the effectiveness of upstream treating.

Table 1 indicates that polymer can contain mercaptans but these compounds are usually converted to alkyl disulfides. Polymer contains some diolefins that promote a rapid sweetening reaction. Alkyl monosulfides can also

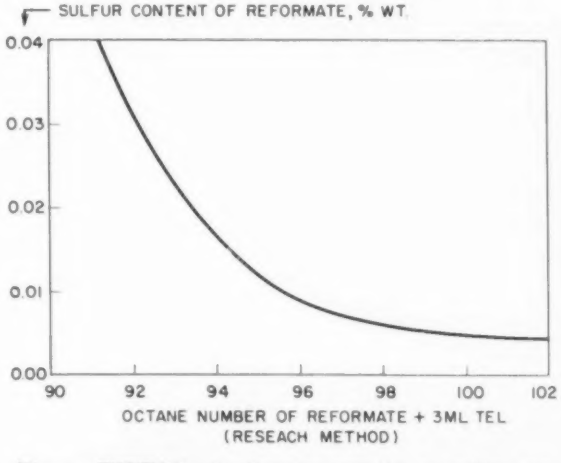

Fig. 1—**EFFECT** of reforming severity on sulfur content of reformate to octane of 102

be present along with traces of free sulfur (not enough to show corrosion by the copper strip test). Once these sulfur compounds exist in the polymer they cannot be removed without incurring a loss of high-octane components. Although mercaptans can be eliminated by effective caustic washing, some quickly convert to disulfides that cannot be removed by caustic treatment.

Plants using polymer gasoline as a constituent of 100-octane gasoline would do well to appraise this source of sulfur. This is particularly true where the feed material is being treated to remove sulfur compounds.

Consider a plant, with cracking facilities, processing a crude that contains sulfur. Gas recovery probably includes an ethanol amine system to eliminate hydrogen sulfide. Caustic washing is generally practiced as a clean-up to remove any traces of hydrogen sulfide and/or mercaptans that are not absorbed during the amine treatment. Operation of the caustic-wash system is critical, and this is the point at which sulfur can be almost entirely eliminated from the polymer. In some cases, it may be economical to add another stage to the caustic-wash system in order to remove all of the slower reacting ethyl mercaptan (methyl mercaptan reacts rapidly with caustic). If free sulfur is a problem, it can generally be removed from the feed stream by special control of the caustic wash or by the addition of a poly sulfide wash.

Alkylate: Similar reasoning may be applied to the sulfur content of the feed material for alkylation units. In general, feed pretreatment is more critical with alkylation. For example, acid consumption in the sulfuric acid units increases with the amount of sulfur compounds in the feed. (One source indicates that roughly 18 lb of acid are consumed for each pound of mercaptans.) In the HF systems operation is complicated by the presence of sulfur in the feed stream. Therefore, for very practical reasons the sulfur contents of alkylates are much lower than polymers.

With HF alkylation, continuous removal of the acid-soluble oils serves as a sulfur bleed from the unit. If oils are allowed to accumulate in a unit where sulfur containing feed is used, breakdown and discharge of sulfur compounds to the product is possible.

Rerunning is also an effective means of removing sulfur from the final product. When heavy alkylate (5 to 10 vol-%) is removed from the total product, sulfur concentration of this fraction will be three to five times as great as in the light fraction.

Again, the best point of elimination is the feed stream. Frequent laboratory checks for sulfur should be made on the unsaturate charge, isobutane charge, and butane recycle, as well as on the product.

Sulfuric acid systems include the problem of acid and neutral esters in the effluent. These compounds add to the total sulfur content and cause equipment corrosion and exchanger fouling. Conventional treatment with caustic generally removes about 60 percent of these troublesome by-products. Recently a new treating process[1] employing bauxite adsorbtion was jointly developed by D-X Sunray Oil Co. and M. W. Kellogg Co. Removal of 98 to 99% of the sulfur compounds is claimed for the process. Corrosion and fouling problems are reduced and alkylate TEL susceptibility is improved.

Pentane and hexane isomers: Super fractionation of light straightrun cuts has been used to separate pentane and hexane isomers, but the high cost of this operation has limited this source of high octane blending material. These fractions were used to a large extent during World War II as components of aviation gasoline. Sulfur content is entirely dependent upon the crude source and may range from practically nil to 0.05%. All sulfur compounds in these fractions except monosulfides are readily removed by caustic washing.

Catalytic isomerization, when combined with fractionation, can convert a high percentage of normal pentanes and hexanes to the iso-compounds. In one process[4] those pentane and hexane fractions passing through the reactor section are subjected to desulfurization as a result of treatment with hydrogen under isomerization conditions. Therefore, the sulfur content of the product is extremely low.

Catalytically cracked gasoline: Catalytically cracked gasoline fractions are by far the largest contributors of sulfur compounds to 100-octane gasolines. Research and technology have progressed steadily toward the removal of the last increment of sulfur from these fuels and the natural target has been the cracked gasolines. Recent advances in this field will be discussed later.

Catalytically cracked gasoline can contain from 0.02 to 0.25% sulfur, depending upon the type of cracking feed stock, type of catalyst, cracking severity, final treating conditions, etc. Both alkyl and aryl mercaptans, monosulfides, and disulfides may be present, along with thiophenic or cyclic sulfur compounds. Numerous conventional treating methods are available for elimination of the mercaptans. How completely and rapidly the mercaptans are removed will, of course, determine the ultimate disulfide content of the product. Three-stage caustic washing is extensively practiced in this service. The use of promoters, whether natural or additive, will greatly aid the solution of mercaptans in caustic. Operating techniques used in caustic-wash systems will have a great deal of bearing upon how much of the removable sulfur is converted to disulfides.

Previous years have seen extensive use of various sweetening reactions in order to convert mercaptans to disulfides and thus "sweeten" the gasoline. The industry trend is now toward removal rather than conversion of the mercaptans because of the rather severe loss in TEL efficiency caused by presence of disulfides. With the current cost of octane improvement, economics

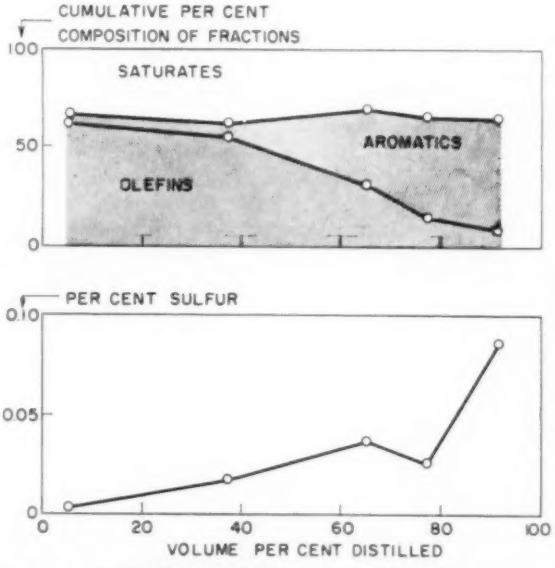

Fig. 2—**HYDROCARBON** and sulfur distribution—F.C.C. gasoline

Table 2—Octane* improvement costs with TEL
(Various high octane stocks)

Stock	RON, clear	RON + 3 ml TEL/gal	TEL costs of ave. octane improvement, ¢/RONB
Reformate (Severe operation)	95.0	101.5	4.2
Rexformate	98.0	102.4	6.3
Fluid cat. cracked	93.5	98.5	5.5
Alkylate (HF)	93.0	105.0	2.3
Propylene polymer	93.0	99.0	4.6
Butylene polymer	99.0	102.4	8.1

*GM scale

Table 3—Octane improvement costs

RON	RON Cost ¢/Gal	RON Cost ¢/RONB
90-92	0.2	8.4
93-95	0.25	10.5
95-97	0.4	16.8
97-98	0.5	21.0
98-99	0.6	25.2
99-100	0.7	29.4

Table 4—Additional RON possible with 75% sulfur (thiophenic) removal
(100 + RON gasoline @ 3 ml TEL/gal)

Gasoline susceptibility RON, clear	Gasoline susceptibility RON 3 ml TEL	RON gain possible @ 100 + RON @ 3 ml TEL/gal at various thiophenic sulfur levels 0.01%	0.02%	0.03%	0.04%
95	105	0.55	0.80	1.0	1.15
95	104	0.45	0.65	0.75	0.85
95	103	0.35	0.55	0.65	0.75
95	102	0.30	0.50	0.55	0.65
95	101	0.25	0.45	0.45	0.60
96	100	0.20	0.30	0.35	0.35
95	100	0.25	0.35	0.40	0.45
94	100	0.30	0.45	0.50	0.55
93	100	0.35	0.55	0.60	0.65
92	100	0.40	0.65	0.70	0.75
91	100	0.45	0.75	0.80	0.85

Note: RON gain is stated conservatively because least antagonistic thiophenic sulfur is shown removed. RON gain would be greater if other sulfur compounds were removed.

may favor changes in treating methods in order to effect complete removal of the caustic-soluble sulfur compounds.[22] Ideally, all sulfur can be so removed except the monosulfides and cyclic sulfur compounds.

Light catalytically cracked gasoline has become a popular component of 100-octane gasoline. Just how deep the cut is made depends upon what other stocks are available for the 100-octane gasoline, the gasoline grade ratio, the type of cracking, the sulfur content of the cracked gasoline, etc. In any case, if 25% of the heavy end is cut from full-boiling cracked gasoline, a large proportion of the cyclic sulfur compounds will be in the heavy fraction. Sulfur types in the light fraction will include some cyclic sulfur along with monosulfides. When high-sulfur gas oils are being processed, the sulfur content of the light can be appreciable, but is always relatively low as compared to the sulfur content of the heavy cut. Hydrocarbon and sulfur distribution are shown in Fig. 2 for a typical low-sulfur (0.036%) cracked gasoline. A cracked gasoline containing more sulfur would have similar sulfur distribution, but proportionately higher.

The hydrogen treating processes, which will be discussed later, are generally impractical from the standpoint of the light cut, because high-octane olefinic material would be saturated in the process of eliminating sulfur compounds.

Today, common refinery practice is to split the catalytically cracked gasoline, and use the light fraction in 100-octane gasoline. The heavier fraction is then diverted to a premium fuel of lower octane number or to regular gasoline. Primary impetus for this practice is the desire to achieve effective octane distribution. The economics of sulfur redistribution is also very favorable because the greater percentage of sulfur compounds are placed in the lower octane grades, where octane improvement is not nearly as expensive.

Calculate the dollar loss

The octane loss caused by sulfur in a finished gasoline is the result of sulfur antagonism to tetraethyl lead. A given amount and type of sulfur will cause a definite loss of TEL efficiency[17][19], which may be calculated and converted to dollars and cents. This is an accepted economic approach as long as octane improvement by means of TEL and processing are in a competitive cost range. If the TEL loss from sulfur antagonism is large enough, then further treating can often be justified.

Octane improvement costs

In the blending of 100-octane fuels, octane improvement economics are such that the use of maximum tetraethyl lead is extensively practiced. Even with very low susceptibility—say a three Research octane number increase using 3 ml TEL/gal—octane improvement costs with TEL will average 9¢/RONB (cents per Research octane number per barrel). Because most stocks have a higher susceptibility, the average improvements costs with TEL are lower, as shown in Table 2.

Much higher octane-improvement costs are evident when processing costs are included in the economic study of 100 octane fuels. It is interesting to note the sharp rise in the cost of octanes at the 100 level. One estimated example, recently published, is shown in Table 3[5].

Octane improvement or TEL savings

Many times, refiners meet rigid restrictions when projecting production of a 100 octane fuel. The individual refiner is pretty much interested in another "number" in the 100 range, and isn't too particular about just what type of refining effort it takes to produce it. It is all pretty well summed up by the question refiners have been asking for the past several years, "How can I get more octane?" One answer is by desulfurization and the resultant extension of TEL's utility. More effective utilization of TEL can produce more 100 octane pool numbers and may be evaluated as an octane-improvement process, as shown in Table 4 and Fig. 3 and 4. Therefore, cost studies of desulfurization should be appraised on the basis of marginal *octane improvement* processing and other benefits rather than TEL savings.

Pay-out for desulfurization

Although various companies will have slightly different octane cost scales, one thing is certain—the costs will

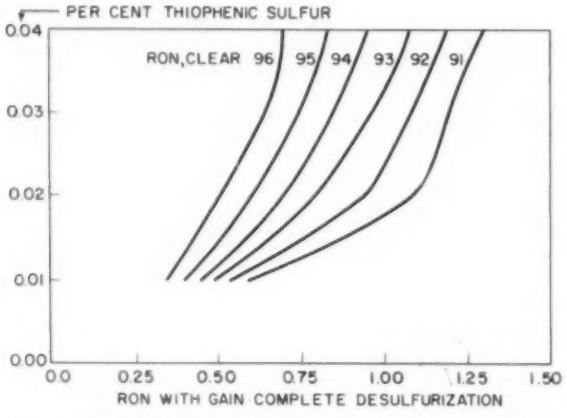

Fig. 3—**ADDITIONAL RON** possible with complete desulfurization of 100 RON at 3 ml TEL/gal

all be high. This should place more financial incentive in the hands of the refiner for desulfurization processes aimed at high octane stocks containing appreciable amounts of sulfur.

How about motor octane number?

Research octane is the accepted specification and method of gasoline blending control in the petroleum industry today. Less than a year ago, when 100-octane gasolines were first placed on the market, competing refiners had to select the most economical blending approach and still maintain all other gasoline specifications. Some refiners had very limited means to blend a 100-octane gasoline. Those who have chosen to stay out of this phase of the business have generally raised the Research octane quality of premium gasolines. An overall effect was to increase the percentage of sensitive (olefinic and aromatic) blending stocks, which have a large difference between the Research and Motor method ratings, in the premium fuels. This was particularly true in the 100-octane gasolines.

It was almost immediately realized that the Research octane number of gasolines containing high percentages of the sensitive stocks might be depreciated in the automotive engine.[11][6] In order to maintain quality and still use a laboratory control, Motor-octane specifications have sometimes been stated along with the usual

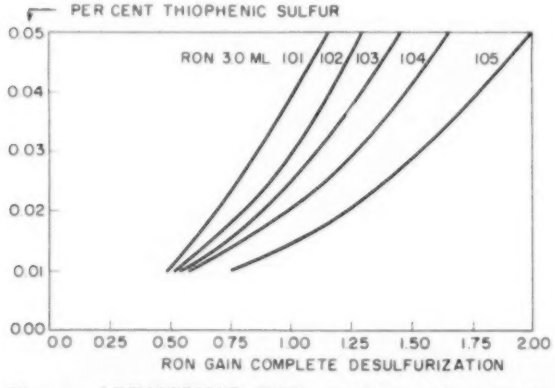

Fig. 4—**ADDITIONAL RON** possible with complete desulfurization of 100+ gasoline at 3.0 ml TEL/gal

Research-octane specifications. This either limited the amount of sensitive material that could be used in the 100-octane gasoline or it forced the Research rating higher than specification (i.e., 100 RON) in order to meet the required Motor rating. (In all probability, higher priced alkylate or iso-pentane had to be used as an alternative in order to raise the Motor octane number.) In other words, it might be said that Research octane numbers had to be given away in order to meet a Motor octane requirement and maintain road performance at a desired level.

It has been shown by investigators[17][19], who averaged the results of numerous tests, that there is no significant difference in the effect of sulfur compounds on volume of tetraethyl lead required, as measured by Research and Motor methods. This means, of course, that Motor octane numbers are lost, as well as Research octane numbers, because of the presence of sulfur in leaded fuels. In the specific instance described above, desulfurization of a 100-octane gasoline could mean savings through one of the following effects:

1. Leaded sensitive blending stock would have higher Motor and Research ratings. Thus sensitive stocks could be used more effectively.
2. A given leaded Motor octane requirement might be met with a lesser amount of alkylate or other high octane paraffin.
3. A given leaded blend would probably have enhanced road performance, as indicated by higher Motor and Research ratings.

It should be understood that the above reasoning is based upon average results, and that specific cases may deviate from the average[19]. Therefore, each blending situation must be appraised upon individual merit.

Importance of sulfur bearing stock

It has been shown that much of the blending stock selected for compounding high octane gasolines is very low in sulfur content. The present exception is where stocks or processing equipment are limited and gasoline with higher sulfur content must be used.

One fact remains, however. Sooner or later the demand for high octane gasolines will reach a point where greater utilization of light catalytically cracked gasoline is inevitable.

Catalytic reforming is somewhat limited by the amount of feed stock that can be produced. This is further aggravated by product losses, which became rather high when producing 100-RON stock. One source[12] estimates this raises octane-improvement costs to 0.75 to 1.0 cents per octane gallon (31.5 to 42¢/RONB).

Alkylation still has very definite limitations as a source of blending stock for motor fuel, because of limited feed material and continued commercial and military aviation-gasoline requirements. Although butane dehydrogenation could raise the ultimate amount of alkylate available for motor fuel, economics make this approach quite selective at the present time. Catalytic isomerization appears to have an excellent future[4], and present thinking involves combining this stock with reformate to make a desirable 100-octane gasoline. This is particularly true from the standpoint of the requirements of present-day automotive engines. Nevertheless, optimization of blending economics will (in most cases) take the refiner back to the catalytic cracking unit to provide a component to supplement reformate, because it still provides the major portion of high-octane material in most gasoline pools[23]. On this basis, sulfur will be a factor

to contend with in the future[24], as well as in some present-day high octane gasolines.

Sulfur a growing consideration

Recent price increases for 15° API to 35° API high sulfur crudes[7] in the Rocky Mountain area reflect the future value of the heavier crudes. The price increase ranged from one to forty cents per barrel, with the premium price on the heavy crude. Thus, sulfur will be a growing consideration as more feed stocks for catalytic cracking are provided by scraping the bottom of the barrel for deeper vacuum cuts, more coker gas oil, and more solvent deasphalted gas oil[23]. Recent developments also make it possible to catalytically crack the whole crudes or residue that has a high percentage of sulfur[6]. Sulfur-bearing shale oil also appears to be a crude oil to contend with in the future.

Solutions to the sulfur problem

Fortunately, the reformer has not only provided a high-octane blending stock, but also the reagent (hydrogen) to help solve the sulfur problem of cracked gasoline. Recent advances in hydrogen processing are already working to this end. One method of attack is direct treatment of catalytically cracked naphtha.

Selective hydrodesulfurization of cracked gasolines

Houdry Process Corp.[16]—Cracked gasolines with relatively high sulfur content can be selectively hydrodesulfurized without extensive hydrogenation of olefins and aromatics. Ring type sulfur compounds, which constitute a large percentage of all sulfur compounds in catalytically cracked distillates, are converted to hydrogen sulfide. A minor loss of clear octane rating results from hydrogenation of unsaturates, but this is generally more than compensated for by the improved lead response resulting from desulfurization. Best results are obtained by the hydrogenation of the high-boiling, sulfur-rich, low-olefin fractions of gasoline. A cobalt-molybdena-alumina catalyst is used at 300 psi pressure and temperatures in excess of 650° F. It is claimed that this process achieves over 80% desulfurization of the heavy fraction. Catalyst life, prior to regeneration, is estimated at 100-200 barrels of low-sulfur gasoline per pound of catalyst.

Vapor-phase hydrodesulfurization

Shell Development Co.—This is another process that may be used for selective desulfurization of catalytically cracked naphtha, with a minimum of olefin saturation.

Two units have been operated by the Shell Oil Company for over a decade at Dominguez, Calif., and Wood River, Ill. It is interesting to note that treatment of cracked naphtha from Los Angeles Basin crude (0.28% sulfur lowered to 0.003%) improved blending octane (D-610 aviation) from 76 to 96 numbers at the 4.6 ml TEL level.

Capital and operating costs, operating conditions and catalyst descriptions are completely described in several recent publications[18][15][10].

Hydrofining

Esso Research and Engineering Co.—Hydrofining has also been applied to cracked naphthas[24] using mild operating conditions. According to data presented in Table 5, 60% desulfurization was effected with a resultant gain in Research octane number at 2 ml TEL/gal. Stability was also greatly improved with no product loss from the operation.

Another approach that will increase the quality of catalytically cracked gasolines is to treat the feed stocks in a hydrogen process, and thus eliminate sulfur, nitrogen, and metal contaminants from the charge stock. Additional benefits include longer catalyst life and improved gasoline yields. Improved yields and quality of cracked gasoline may be partially explained by saturation of aromatic cycle oils. Gasoline is generally more stable and has a higher leaded octane number because of sulfur elimination and altered hydrocarbon composition. Several processes involving hydrogen treating various charge stocks for catalytic cracking are described in recent publications[18][15][10][13][24], and include:

Unifining—UOP and Union Oil Co. of Calif.
Hydrofining—Esso Research and Engineering Co.
Trickle Hydrodesulfurization—Shell Development Co.
Hydrodesulfurization—Standard Oil Co. of Calif.
Hydrogen Treating—Sinclair Refining Co.
Gulf HDS—Gulf Oil Corp.

Perhaps sodium dispersion

It has long been known that sodium, either by itself or in the presence of accelerating agents, will readily react with organic sulfur compounds. Thiophenic or cyclic sulfur compounds are no exception and, with the proper treating conditions, virtually completed desulfurization may be effected. In addition to desulfurization, an improvement in odor, color, dissolved gum, and stability has been noted. Such treating should be very effective in reducing deposits that are often attributed to contaminants of heavy fractions of cracked naphthas, particularly in the high-compression engines requiring high octane gasoline. An attractive feature is that sodium may not react with olefins—one of the difficulties experienced in hydrogenation of cracked naphthas.

To date, cost has made sodium treating unattractive. TEL savings from octane improvement, and other benefits previously mentioned, could not justify installation and operating costs. However, considering the costs of octane improvement in the 100-octane range, it is entirely possible that sodium treating could fall within the scope of refinery economic studies of desulfurization.

Sittig[21] has described the use of sodium dispersions for continuous treating of petroleum fractions. Sulfur-bearing gasoline is intimately mixed with dispersed so-

Table 5—Hydrofining mixtures of coker naphtha and heavy catalytic naphtha

	Feed stock	Product
Sulfur, per cent by weight	0.30	0.12
Bromine number cg per g	41	33
Gravity, °API	39.2	40.1
Gen. Motors gum content (mg/100ml)		
No inhibitor	45	6
With 1 #/5000 Gal	35	8
ASTM breakdown (2 lb per 5000 gal) min.	200	1000 +
CFR Research octane number:		
Without TEL/addition	89.0	88.5
With 2 ml TEL/Gal	93.0	93.5

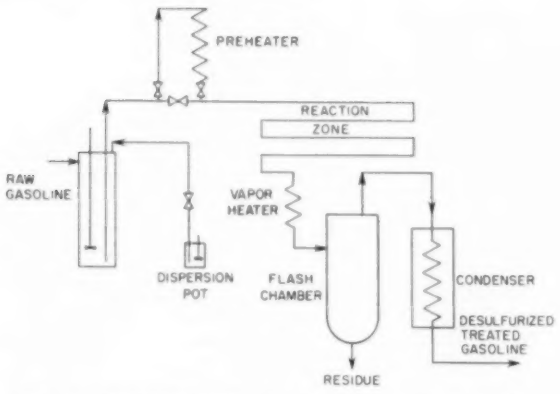

Fig. 5—EQUIPMENT of sodium treating of gasoline

dium and heated to the reaction temperature. Desulfurized gasoline is separated from the reaction residue by rerunning or filtration. Sodium concentrations as low as 0.25 wt-% have been effective in improving stability. Fig. 5 shows the equipment that has been used on laboratory-scale sodium treatment of gasoline.

What does all this mean?

The presence of small amounts of sulfur compounds in finished leaded gasoline represents losses in both Motor and Research octane numbers that may become very costly in the 100-octane gasolines. Catalytically cracked gasoline and its fractions contribute to most of the sulfur in today's high octane fuels. Present conventional treating methods enable the refiner to eliminate all of the alkyl and aryl mercaptans and thus prevent the formation of disulfides.

The problem of disposing of the remaining cyclic sulfur and monosulfides poses a challenge to the industry. To be sure there are processes to handle this job at the present time, but not without disadvantages, such as product losses, saturation of high octane components, and incomplete desulfurization.

Desulfurization of the cracked constituents of 100-octane gasoline is in its infancy. Whether it will continue until the final increment of sulfur is removed is an economic problem based on just how much octanes are worth, and on whether additional benefits from lessened engine deposits and fuel stability will warrant the necessary expenditure. All indications are that work will continue toward the removal of the final increment of sulfur.

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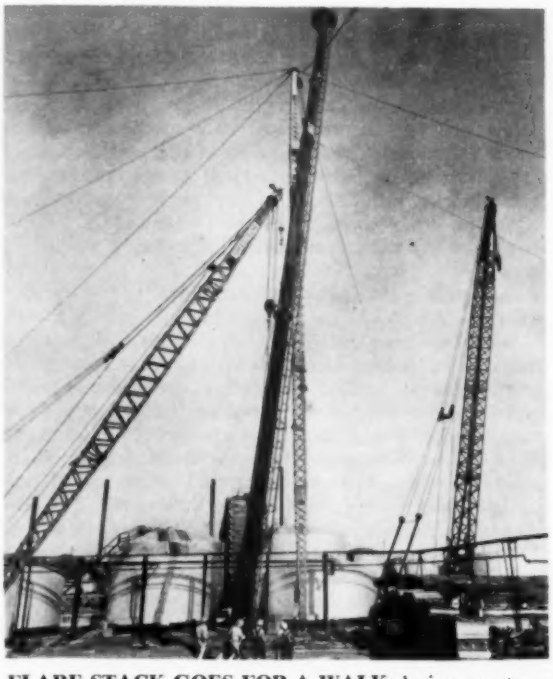
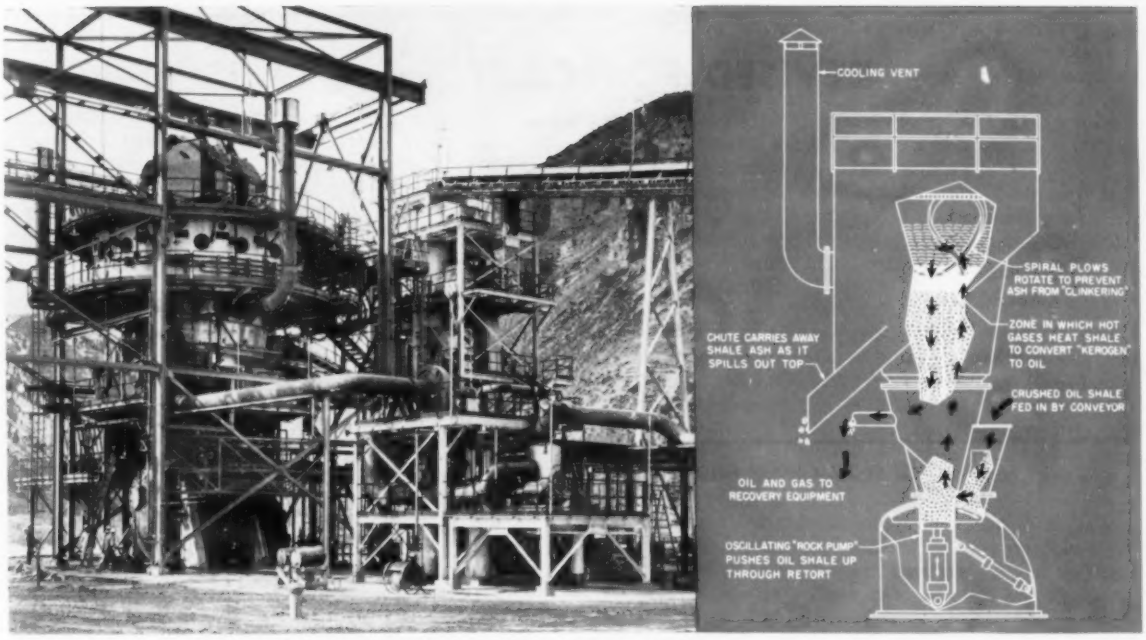
NEWS in VIEWS



FLARE STACK GOES FOR A WALK during construction of Cities Service Oil Co.'s new Rexforming unit at its Ponca City, Okla., refinery. The Procon crew is using a 140-ft gin pole to handle the 225-ft stack.


COOLING VENT
SPIRAL FLOWS ROTATE TO PREVENT ASH FROM "CLINKERING"
ZONE IN WHICH HOT GASES HEAT SHALE TO CONVERT "KEROGEN" TO OIL
CHUTE CARRIES AWAY SHALE ASH AS IT SPILLS OUT TOP
CRUSHED OIL SHALE FED IN BY CONVEYOR
OIL AND GAS TO RECOVERY EQUIPMENT
OSCILLATING "ROCK PUMP" PUSHES OIL SHALE UP THROUGH RETORT

UNION OIL'S NEW RETORT in the Colorado Rockies and how it works. The unit points to an increased emphasis on . . .

Shale Oil Research—King-Size

A $12-MILLION investment and what is probably the largest piece of research apparatus in the world is the nutshell description that pegs Union Oil Co. of California's shale oil research installation now in operation at Grand Valley, Colo., near Rifle, in the Rocky Mountains.

Center of the operation is the shale retort, in which much of the basic experimental work will be carried out. Tall as a six-story building, but dwarfed by the surrounding mountains, this unit has a design capacity of 300 t/d, considerably larger than any earlier pilot models Union Oil has worked with. It took nearly two years to build the retort and its auxiliary equipment—crushers, conveyors, and other more conventional ore-handling machinery.

Feed to the retort comes from strip mining operations in this Piceance Creek oil shale basin of Colorado. Union Oil spent about $5-million for acquisition, exploration and preliminary experimental work before building the retort. Add to this some $7-million spent at the company's Research Center in California, and you have the $12-million. This does not include costs for current operating expenses.

The specific location of Union Oil's oil shale operation—the so-called Mahogany Ledge—is a rich source of recoverable oil. The 90 to 100-ft thick layer of rock has an average recoverable oil content of about 32 gal (0.75 bbl) per ton of rock. The Ledge contains an estimated 100 billion bbl, over 2½ times the total known reserves of the United States. About 10% of this oil can be recovered from the visible outcroppings alone.

And in the cliffs surrounding the Mahogany Ledge is stored what some authorities regard as the greatest concentration of potential energy to be found anywhere in the world—estimated by the Bureau of Mines to be as much as one trillion bbl of recoverable shale oil—over six times the known petroleum reserves of the entire world.

Oil shale has to be mined, then the oil content is recovered, and this crude shale oil refined by conventional methods. The retort is, of course, not a commercial unit. Strictly a large-scale research tool, it's used to learn how to recover the crude shale oil in large volumes and at a cost that would make the entire process of mining, retorting, and refining competitive with natural crude oil.

A precise timetable is still unknown. By the end of this year, Union Oil hopes to have most of the answers to the economic possibilities of the process insofar as they can be controlled.

In addition to the conventional petroleum products that can be made from recovered shale oil are, of course, such materials as gas coke (good sources of cheap fuel), and such interesting petrochemical starting points as nitrogen, sulfur, and refinery gases.

Our Cover

. . . this month includes a view of Union Oil Co.'s shale oil research facilities surrounded by Colorado's Rocky Mountain scenery.

REVISED FORECAST for 1957

(1000 b/d average)

	Forecast Jan. 1, 1957	Forecast at Mid-Year	Up	Down
Total Demand	9,644	9,730	66 (0.7%)	—
Gasoline	4,072	4,066	—	6 (0.1%)
Distillate Fuel Oil	1,903	1,921	18 (0.9%)	—
Kerosine	340	337	—	3 (0.9%)
Residual Fuels	1,661	1,645	—	16 (1.0%)
All Other	1,688	1,761	73 (4.3%)	—
Export Demand	323	504	181 (56%)	—

THE SUEZ CRISIS FORCED a revision in export trade forecasts in the . . .

Mid-Year Supply-Demand Outlook

The Mid-Year supply-demand roundup of PETROLEUM PROCESSING reviews the actual trend for the first six months and revises the forecasts for the last six months, its data being consolidated from the individual reports sent its Editors by oil company economists and other authorities.

Contributing to the 1957 Mid-Year report are authorities with American Petroleum Institute, Chase Manhattan Bank, Independent Petroleum Assn. of America, Atlantic Refining Co., Continental Oil Co., Ohio Oil Co., Phillips Petroleum Co., Pure Oil Co., Shell Oil Co., Standard Oil Co. (Indiana), Standard Oil Co. of Calif., Sun Oil Co., the McGraw-Hill Economics Dept., and others.

By VIRGIL B. GUTHRIE
Associate Editor

REVISED FORECASTS by PETROLEUM PROCESSING of 1957 U. S. demand for petroleum products point to these five important developments:

1—Total demand will average 9,730,000 b/d, a little higher than the 9,664,000 b/d average forecast at the start of the year, but 5.9% higher than actual demand in 1956. The current higher estimate is entirely caused by the emergency exports to Western Europe in the early part of the year.

2—Of the revised 1957 total demand, domestic shipments will be 9,226,000 b/d average, a little less than the 9,341,000-bbl estimate made at the start of the year. The drop in the current forecast is mainly because of the less-than-normal heating oil consumption in the late heating season.

3—Petroleum export trade, even with the program of emergency shipments to Europe concluded, will average 504,000 b/d over the year. This is 56% larger than the "normal" exports of 323,000 bbl daily forecast at the start of the year.

4—Total demand for the last six months of 1957 is now forecast at 9,558,000 b/d average, a gain of 4.7% from the actual demand for the last half of 1956, and indicating that the trade of U. S. oil companies is back in the groove after the abnormal demand in the first six months The current forecast for the last six months of the year is slightly less than that made at the start of the year.

5—Even with the high total demand forecast for 1957 it is now indicated that crude runs to stills with imports of heavy fuel oils will create a product supply that will add some 15-18,000,000 more barrels to product inventories than is adequate for market needs. PETROLEUM PROCESSING forecasts that adequate stocks of gasoline, kerosine, distillate fuel and residual fuel on Dec. 31, 1957, would be around 387,000,000 bbl. On this date in 1956, actual stock of these products totaled 397,200,000 bbl.

Total estimated demand of 9,730,000 b/d average over all of 1957 reflects the high rate of shipments of around 9,907,000 b/d average for the first six months. The first six months' shipments, as now estimated, were 7.2% higher than actual demand for the same period in 1956.

Export demand in the first six months, swollen by the emergency shipments to Western Europe, to fill in part the vacuum created there by the closing of the Suez Canal, reached 679,000 b/d average, more than double total exports in the first half of 1956. In the period from February through April, the abnormal shipments to Europe averaged over 600,000 b/d average.

For the first six months, total domestic demand was 9,228,000 b/d average, only 3.4% greater than actual shipments in the same period in 1956. This relatively

small rate of gain was caused by smaller heating oil consumption, in the latter part of the winter, than had been originally forecast. Representative areas over the country experienced 11% fewer Degree Days in the 1956/7 heating season than in the 1955/6 season, and 6% fewer than normal. In the East Coast area of heavy oil consumption, the deficiency was 10%.

As a result of the warmer winter, domestic distillate fuel oil demand in the first six months was only 2.9% greater than in the same months in 1956, residual fuel oil demand only 0.2% larger, and kerosine demand 0.8% less. The cool, wet spring also held the gain for domestic gasoline demand in the first six months of 1957 to 4.5% larger than for the same 1956 period.

For the last six months of 1957, the revised forecast of total petroleum demand is 9,588,000 b/d average, which will be a gain of 4.7% from the last six months of 1956. Total domestic demand for the period is now estimated at 9,225,000 b/d average, a gain of 7.3% from the 1956 period, and a much larger rate of gain than in the first six months of 1957. Of the mass volume products, the largest gains will be in heating oils. Forecasts for demand for these products are based on normal temperatures during the coming winter. They show a considerable rate of gain when compared with actual demand during the warmer than normal past winter.

Revised domestic gasoline demand for the coming last six months is 4,045,000 b/d average, 6.2% greater than for the same period in 1956, and a larger rate of growth than is estimated for the first half. A greater volume of touring than ever before will contribute to the gain here. In the areas where new highways are being opened, some oil companies believe that touring will be 10% larger than last summer. Domestic gasoline demand for the third quarter is forecast at 4,160,000 b/d average, reflecting earlier touring.

Total exports for the last half of 1957 are now forecast at 333,000 b/d average, a drop of 38% from the 535,000-bbl rate for the last six months of 1956, which includes two months of emergency shipments to Europe. The largest declines in exports will be in the light heating oils.

Crude runs to refiners' stills, which averaged 8,120,000 b/d during the first six months, to meet the high rate of demand of 9,907,000 b/d average, are expected to be further stepped up to 8,210,000 bbl in the third quarter, and 8,315,000 bbl in the fourth quarter. For all of 1957, it is estimated, crude runs will average 8,192,000 b/d, to meet the overall product demand of 9,730,000 b/d average.

This indicated rate of supply, higher than gain in demand, does not augur well for holding product stocks in line with market demand over the rest of the year. At the end of April, these inventories of gasoline, kerosine, distillate fuel oils and residual fuels were nearly 30,000,000 bbl higher than at the same date in 1956, mainly because of the smaller demand for heating oils than had been anticipated.

Petroleum Processing's Revised Forecast of 1957 Petroleum Demand

(1000 b/d average)

	First 6 Mos.*		Third Quarter**		Fourth Quarter**		All 1957**	
	bbl	% Chge. from '56	bbl	% Chge. from '56	bbl	% Chge. from '56	bbl	% Chge. from '56
DOMESTIC DEMAND								
Gasoline	3,883	+ 4.5	4,160	+ 6.3	3,931	+ 6.1	3,965	+ 5.3
Kerosine	331	— 0.8	212	— 8.1	422	+10.3	324	+ 1.3
Dist. Fuel Oil	1,905	+ 2.9	1,216	+ 5.9	2,191	+16.2	1,803	+ 7.1
Resid. Fuel	1,663	+ 0.2	1,300	+ 4.0	1,694	+ 3.7	1,564	+ 1.9
All Other	1,476	+ 6.0	1,729	+ 7.7	1,595	+11.5	1,570	+ 7.9
Total Domestic	9,228	+ 3.4	8,617	+ 5.7	9,833	+ 8.8	9,226	+ 5.4
EXPORTS								
Gasoline	114	+ 37.3	92	—10.7	86	—28.3	101	+ 4.1
Kerosine	18	+157.1	7	+40.0	8	—55.6	13	+44.4
Dist. Fuel Oil	170	+165.6	72	—	64	—63.8	118	+25.5
Resid. Fuel	90	+ 36.4	76	— 6.2	67	—25.6	81	+ 6.6
All Other	287	+181.4	98	—10.1	96	—67.6	191	+25.7
Total Exports	679	+110.9	345	— 6.8	321	—54.2	504	+17.8
TOTAL DEMAND								
Gasoline	3,997	+ 5.2	4,252	+ 5.8	4,017	+ 5.0	4,066	+ 5.3
Kerosine	349	+ 2.3	219	+15.3	430	+ 7.5	337	+ 2.4
Dist. Fuel Oil	2,075	+ 8.4	1,288	+ 5.6	2,255	+ 9.3	1,921	+ 8.1
Resid. Fuel	1,723	+ 1.7	1,376	+ 3.4	1,761	+ 2.2	1,645	+ 2.1
All Other	1,763	+ 18.0	1,827	+ 6.6	1,691	— 2.1	1,761	+ 9.6
Total Demand	9,907	+ 7.2	8,962	+ 5.2	10,154	+ 4.3	9,730	+ 5.9
Crude Runs	8,120	+ 2.7	8,210	+ 2.5	8,315	+ 4.9	8,192	+ 3.2

Forecast of Adequate Levels for Refiners' Product Stocks (1000 bbl)

	Mar. 31, 1957***	June 30, 1957**	Sept. 30, 1957**	Dec. 31, 1957**
Gasoline	203,400	180,500	172,000	183,700
Kerosine	20,000	28,300	35,800	29,100
Dist. Fuel Oil	75,700	102,100	156,600	130,700
Residual Fuel	37,200	42,900	46,700	43,400

*Estimated. **Petroleum Processing Forecast. ***Actual.

Summarized answers to 24 thought-provoking questions on future needs

1—Has there been an increasing trend in the skill requirements involved in manufacturing instrumentation equipment for the petroleum and petrochemical industries?

Yes—22. No—5. Blank—1.

2—Is it expected that the trend expressed in Question No. 1 will continue during the next 5-10 years?

Yes—22. No—2. Blank—3.

If yes, by approximately what percent in 1961 over 1957?

Average—18% (low of 5% to high of 50%).

If yes, by approximately what percent in 1967 over 1962?

Average—12% (low of 0% to high of 100%).

Is the increasing skill requirement advancing at about the same rate in both the supervisory and the hourly fields of work?

Yes—7. No—18. Blank—3.

If no, which is increasing faster?

Supervisory—17. Hourly—1. Don't know—9.

3—If the answer to the first part of Question No. 2 is no, give the reasons.

Simplified design. Better and more automatic tooling in manufacturing.

4—If manufacturing skill requirements will increase, how will the situation be met?

Training programs. Increased use of technical hourly personnel. Better use of individual's ability. Increased use of graduate engineers.

5—In your opinion, would increased manufacturing complexity be reflected in increased maintenance complexity?

Yes—15. No—6. Not necessarily—6.
Maintenance complexity may increase, but not to the same degree as manufacturing complexity.

6—Which will require more skill of hourly wage personnel, the manufacture or the repair of petroleum and petrochemical instrumentation equipment?

Repair—20. Equal—6. Manufacturing—2.

7—Will the skill requirements in Question No. 6 have the same relationship in 1962?

Yes—27. No.—1.

In 1967?

Yes—27. No.—1.

8—Does your company repair instrumentation equipment?

Yes—27. No.—1.

9—In manufacture of petroleum and petrochemical instrumentation equipment, at which point do you find the highest skill requirement for hourly wage personnel?

Final testing and calibration. Special orders. Machine work. Reworking faulty units.

Will this also be the case in 1962?

Yes—27. No.—1.

In 1967?

Yes—27. No.—1.

10—Do hourly wage people analyze and correct inspection test failures?

Yes—19. No.—1. Blank—1.

11—How do you rate the skill requirement of this work with assembly and other manufacturing functions?

Highest—14. Equal—1. Blank—13.

Will this relationship be the same in 1962?

Yes—20. No—8.

In 1967?

Yes—19. No—9.

12—Which general fields of instrumentation are developing most rapidly?

Data logging. Electronic analyzers. Electronic control. Pneumatic. Hydraulic.

13—List the five fields indicated in Question No. 12 in the order in which it is felt the maintenance skill requirements will be the highest?

A—Data logging. B—Electronic analyzers. C— Electronic control. D—Pneumatic. E—Hydraulic.

14—List the five fields of instrumentation, regardless of rapidity of development, in the order in which it is felt maintenance skill requirements will be the highest.

Tomorrow's Instrument Repairman...

By A. P. OLBRICH, Chief Maintenance Consultant, Refining Dept.

INSTRUMENTS of tomorrow will require less maintenance. But tomorrow's instrument man must have a better concept of processes and electronics. There will be little change in mechanical requirements. In electronics, the life expectancy of components will be much greater than today. Printed circuit cards will be easily replaceable and plug-in component parts will be expendable. These opinions were expressed in answer to a survey sent to a group of instrument manufacturers supplying the petroleum and petrochemical industry.

of instrument maintenance in petroleum and petrochemicals

Same order as in answer to Question No. 13.

15—How and to what extent are graduate engineers used in the assembly, testing, and repair of petroleum and petrochemical instrumentation equipment?

Very little in assembly and repair. Mostly in advisory and supervisory capacity.

Do you expect such usage to increase or decrease in 1962?

Increase slightly.

In 1967?

Increase slightly.

16—To what extent are technicians used in the manufacture of instrumentation equipment? A technician is one with certain skills beyond that expected in the averaged manufacturing job. This includes a general basic theoretical knowledge of instrumentation plus basic knowledge of design, trouble shooting on electronics and the more complex manufacturing. He would also know basic physics and mathematics as applied to his field of work.

Testing and calibration.

In the service department?

Almost entirely.

Will this increase or decrease in 1962?

Slight increase.

In 1967?

Slight increase.

17—In the next ten years, to what extent will technicians be used to replace hourly personnel in the manufacture of instrumentation equipment for the petroleum and petrochemical industries?

Will remain same—17. 30% increase—8.

If increase, what educational background is required?

Service schools—13. College degree—6. Company schools—2. Blank—7.

18—What recommendations as to education level, training, etc., would you make to those charged with the responsibility for maintaining your equipment in order to be prepared for 1962?

Technical schools—8. Two to four years of college—5. Company service schools—5.

For 1967?

Same as answer for 1962.

19—Are outside consultants used in your training programs?

Yes—9. No—18. Blank—1.

Do your suppliers provide any assistance in training your personnel in the use of their equipment?

Yes—13. No—14. Blank—1.

20—Do you have a training school or program for customers? If so, what does it consist of and what are costs?

Two to five days school, no charge—5. Two weeks of school, no charge—10. School longer than two weeks—2.

21—Do you have a field service organization to maintain your more complex instruments?

Yes—25. No—3.

If yes, are both shop and field services available?

Yes—24. Blank—1.

22—If answer to Question No. 21 is no, is a field service organization anticipated?

Yes—4. No—1.

If answer was yes, would both field and shop service be available?

Yes—4.

In what year is it estimated that such services would be available?

In 1957—1. In 1962—1. In 1967—1.

23—What is being done by your company to improve reliability, and to simplify and reduce maintenance?

Simpler design. Better instruction books. Fail-safe operations. Failure alarms and lights. Test points. Plug-in components. Printed circuits. Transistors Self-checking circuit. Modular construction. Ambient condition protection.

24—Give us the benefit of your thinking concerning the instrument maintenance requirements in the petroleum and petrochemical fields 20 years from now.

Electronics will make more intricate instruments possible, but maintenance will be simplified by the use of the principles given in the answer to Question No. 23.

What Training Will He Need?

and C. H. TROTTER, Head of Management Training and Development, Phillips Petroleum Co.

Because of the march toward automation in our newer units, instrument personnel teachers ask if there will be a sufficient number of skilled maintenance men available to service newly developed complex instruments. Will special training be required to provide adequate maintenance personnel? As a result of such questions our survey of instrument manufacturers was made. A summary of the questions and answers is shown in the attached table.

Developing an instrument section usually means training men already

employed. Careful selection along with some aptitude tests, followed by on-the-job training has been usually sufficient to provide adequately trained men for today's job.

Instruments are of the utmost importance to the operation of a plant, and they must be properly maintained for most efficient operations. The trend toward more complex electronic instrumentation may not allow continued use of the present method of obtaining instrument repairmen. Among those best able to tell about future instrumentation requirements are the manufacturers. Future instruments are now on their drawing boards and they have a good idea of what skills will be required to build them and what skills will be needed to maintain them. A number of manufacturers were asked for their views. Their answers are probably typical of the instrument industry view.

Instrument manufacturers were asked which fields of instrumentation are developing most rapidly. Highest on the list were data logging, electronic control and electronic analyzers. This indicates that automatic logging of process data will appear on more new units, that electronic instruments will take over some of the control functions now handled pneumatically or hydraulically and that use of electronic analyzers for control of product purity will become more extensive.

How complex will instruments be?

It might be interesting to note just what degree of skill the manufacturers think will be necessary to make these new instruments. Some are predicting that a higher level of ability in all phases of manufacture will be required. It is most difficult to assign values to skills of this nature, but manufacturers estimate a required increase in ability of 18% by 1962, and 30% by 1967. They also estimate that supervisory skills will have to increase faster than those of hourly wage personnel. All of this is because of entirely new concepts that are being used in these new instruments. These include transitors, printed circuit boards and miniaturized components.

The next logical question might be —will increased manufacturing complexity be reflected in increased maintenance complexity? There is some difference of opinion among the manufacturers. Most of them believe there would be some increase in maintenance requirements. The instrument itself might be more complex— but only because of the increased number of functions it performs. Also, maintenance personnel will be called upon to service a relatively broad range of equipment supplied by different manufacturers. This could mean that it is possible for an individual instrument to remain relatively simple to maintain while, in the aggregate, maintenance would increase in complexity.

Maintenance complexity will increase but not as rapidly as manufacturing complexity because of the efforts of the manufacturers to simplify maintenance.

What are manufacturers doing?

Manufacturers are doing a great deal to minimize maintenance skill requirements. They are very much concerned about continually improving reliability of their instruments. This is probably one of their biggest research problems. Costs, however, are a great factor because it's possible to make very good instruments but at costs too high for the market. New and better designs and new materials that do not increase the cost are foremost factors to manufacturers.

The manufacturers are also trying to simplify maintenance by the use of plug-in component parts. Parts are replaced and repaired later or discarded altogether. By this method, the most complex instruments can be maintained in the field, with a minimum of skill. The ability needed for maintaining such instruments would be primarily in troubleshooting and failure analysis.

Manufacturers are also adding features to aid in troubleshooting. These include such things as failure alarms, fail-safe operation and test points. Although these features are a material aid in instrument maintenance, many customers are said to be unwilling to pay the additional cost.

The manufacturers are all making instruction books as understandable as possible.

Most of the manufacturers have schools to train customer employees in the use of their equipment. These schools are from 2 days to 2 weeks in length, and have no tuition fee. Such training is often a necessary part of the proper installation and utilization of new instrumentation.

Also, manufacturers make field and shop service available for training and maintenance of their equipment. Some of their highest skilled men are in these departments.

Meet the authors

Mr. Trotter

Mr. Trotter, head of management training and development at Phillips, was born in 1915. He received his B.S. degree in civil engineering from the University of Kansas in 1937. Before joining Phillips in 1938, Mr. Trotter spent some time with the Kansas State Highway Commission and the A T & S RR in engineering and construction. At Phillips, he has been engineer-in-charge of the maintenance, methods and equipment section of the refinery department, as well as a member of the construction and maintenance staffs of the Kansas City, Kan., and Phillips, Texas, refineries. Because of his new assignment, Mr. Trotter is resigning his post on PETROLEUM PROCESSING'S M&C Panel.

Mr. Olbrich

Mr. Olbrich, who is replacing C. H. Trotter on PETROLEUM PROCESSING'S M&C Panel, was born in Burlington, Texas in 1918, and attended Texas A & M College where he earned a Bachelor of Science Degree in mechanical engineering in 1939. He worked with Phillips Petroleum Company in the Refining Department for 18 years. During this period he spent 18 months in the United States Navy as an ensign assigned to ship repair work. Mr. Olbrich also worked in the refineries at Okmulgee, Oklahoma, Kansas City, Kansas, and Phillips, Texas, in the following capacities: design engineering, vacuum unit and steam and power generation operations, general maintenance supervisor, assistant mechanical superintendent, and mechanical superintendent. On March 1, 1957, he was transferred to the home office in Bartlesville, Oklahoma, to his present position.

How can we prepare instrument men?

Probably the most logical solution lies in a well-developed on-the-job training program designed to keep today's instrument man abreast of recent developments. Although most of us are now using on-the-job training, greater emphasis on this program will be required in the future.

In the first place, the instrument man will need a better understanding of instrument circuitry and training in the complex electronic phase of the work. In addition, an understanding of electromagnetic principles will be necessary. Undoubtedly, it will be our responsibility to provide this training. It is doubtful that a school will be able to furnish a finished maintenance craftsman. However, schools can provide the necessary basic education. More detailed and specific plant training and experience would still be necessary.

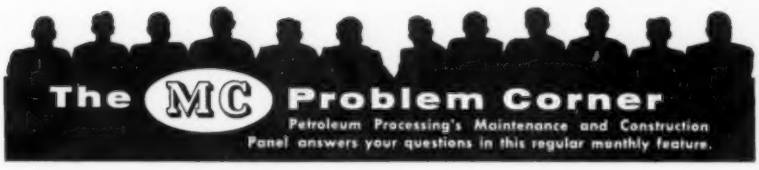
We in industry must make the necessary arrangements to provide the finished maintenance skills to meet future developments. We must also continue to encourage the instrument man to keep up with new developments and increase his knowledge and ability as new-type equipment is used. However, to be improved, the individual must want to improve. No one can be forced to develop. All development is self-development.

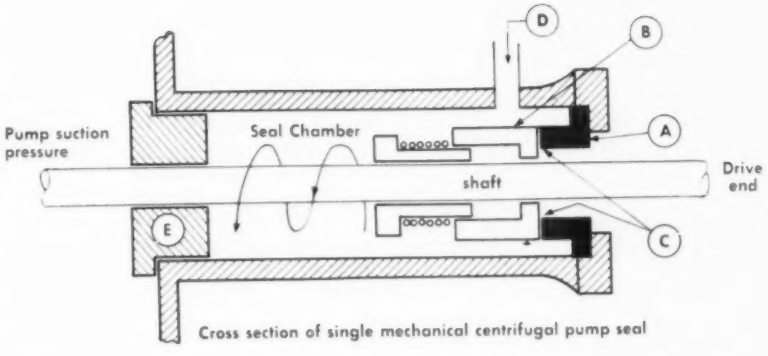
The responsibility for proper development and training of instrument repairmen and of instrument maintenance may require the services of a graduate engineer or his equivalent specifically trained for instrumentation work. This man would also be skilled in operations. One of his important jobs would be to direct the training program of the instrument men.

The present trend in automation indicates that instrumentation in tomorrow's petroleum and petrochemical plants will see greatly increased use of data logging, electronic control and electronic process analyzers. These instruments will be of more intricate design than today's instruments but the use of printed circuits, transitors and plug-in components will simplify maintenance.

As these new-type instruments take their place, emphasis in training repair personnel will shift to process analysis and diagnosis of failures.

The responsibility of selecting instruments, analysis and diagnosis of failures and training of repairmen will probably require a graduate engineer, or the equivalent in practical experience, trained in instrumentation.


The MC Problem Corner
Petroleum Processing's Maintenance and Construction Panel answers your questions in this regular monthly feature.



Cross section of single mechanical centrifugal pump seal

How to stop propane leaks

What can I do about consistently leaky mechanical seals on pumps in wet propane service?
Refining, Southwest.

ASSUMING a proper selection of pump and seal for the desired propane service, the primary causes of seal leakage are improper installation, excessive heat, and foreign particles—including ice.

Single mechanical seals, such as shown in the drawing, are the difficult ones to keep sealed, because they have pump pressure on one side and atmospheric on the other.

The seal drawing represents a cross-section of a typical single mechanical seal installed with a centrifugal pump. This drawing will be used to illustrate the following discussion.

The stationary part of the seal, called the gland insert, is at "A," while "B" is the seal ring that rotates with the shaft. Both are made of antifriction material. Satisfactory propane seal has been obtained with the seal ring "B" of stainless steel with Stellited wearing face and the gland insert "A" of carbon.

A spring holds the face of seal ring "B" under compression against the mating face of gland insert "A" to give a seal at "C."

Proper installation a must

A well-trained mechanic can eliminate many leak headaches. In addition, a few very basic, but sometimes neglected, installation hints are:

1—Proper lapping of seal faces
2—Proper spring tension
3—Proper, corrosion-resistant materials
4—Shaft smooth, straight and round
5—No dirt on mating surfaces
6—No scratches on metallic or carbon rings
7—Carbon and metallic surfaces flat
8—No burrs or sharp particles as the teflon rings are pushed along the shaft
9—Surfaces installed parallel to each other
10—Seal gland square
11—Seal gland not so tight as to distort the insert face
12—Smooth radius on teflon packing rings where they are started onto the shafts or sleeve
13—Shaft thrust end-play a maximum of 0.002-0.003-in.

Seal spring tension is important. Some manufacturers have preset tensions on seal springs, while others must be set at the installation.

Where there is positive suction head on a pump, all the tension needed is enough to keep the running surfaces together (inside seal) while the pump is not in operation.

Often a seal will run better and last longer if the spring tension is not as tight as recommended by the manufacturer.

For continuation of this M&C Problem Corner reply, see next issue.

WHEELER

McGREGOR

LOGWINUK

MADDOCKS

THORNTON

HAIG

FORTER

HARDCASTLE

BOCHOW

JONES

HOUSER

PETROLEUM PROCESSING tape recorded the last regional meeting of the Western Petroleum Refiners Ass'n in El Dorado, Ark. Here is the fifth series of technical tips on processing problems from the complete transcript (checked for accuracy by each speaker). Moderator of the panel of authorities that answered all questions was Harry K. Wheeler of Pan-Am Southern Corp., El Dorado, Ark. Members of the panel were: D. W. McGregor, Lummus Co.; Dr. A. K. Logwinuk, Houdry Process Corp.; R. R. Haig, Esso Research and Engineering Co.; A. A. Forter, Cities Service Refining Corp.; C. A. Hardcastle, Lion Oil Co.; Carl E. Bochow, Suntide Refining Co.; Bruce Jones, McMurrey Refining Co.; Mark E. Houser, Republic Oil Refining Co.; R. R. Maddocks, Blaw-Knox Co.; and D. P. Thornton, Jr., Universal Oil Products Co.

This month's technical tips on . . .

Catalytic Reforming Problems

? **Catalyst poisoning:** Do poisons such as arsenic effect catalyst activity? How effectively does a cobalt moly feed pretreater remove lead, arsenic, and chloride? Will TEL poison a molybdenum catalyst? What is the mechanism of catalyst deactivation when the catalyst is free from poisons and shows low carbon content?

Logwinuk: The answer to good reforming is to keep poisons out. Arsenic has a tremendous affinity for platinum. It destroys the active centers by formation of an alloy with the platinum. When this happens, the activity ceases to exist and you no longer have a catalyst. A cobalt moly pretreater very effectively removes lead, arsenic, chloride, etc.

There are several plausible explanations for operations in which there is apparent poisoning or reactivation of the catalyst, without presence of poisons and showing low carbon content. In a unit that is being watched carefully, it is difficult to visualize, but possible, that the temperature might run away. It's particularly possible during the regeneration cycle. Elevated temperatures may cause transformation of the active form of the alumina carrier to the inactive. Nitrogen, which is generally not considered a poison as such, or the loss of chloride, can also cause the deactivation.

The lead in TEL can poison a molybdenum catalyst the same as lead in any other form. However, if we're considering a pretreating catalyst, there is so much metal available that large quantities of lead can be taken up before showing up in the reformer feed stream.

I am not familiar with the effect of lead (TEL) upon molybdenum reforming catalyst.

Mr. Maddocks

Maddocks: I would like to make mention of a brochure titled "Preparation of Petroleum Feeds for Platinum Catalysts" presented by Minerals and Chemicals Corporation of America. This publication reviews the subject and discusses various contaminants found in feed stocks. More specifically, it discusses contaminants such as arsenic, lead, sulfur, nitrogen and also water, and points out to what level these contaminants should be reduced for satisfactory operation. The effectiveness of clay treating to remove these contaminants is reviewed. And data and information is presented that lets you design, in your plant, a cold clay treating system. I would suggest anyone confronted with such a problem obtain this bulletin—it is certainly worth while.

? **Aluminum-coated piping:** Has anyone had any experience using aluminum-coated piping and tubing to combat corrosion in catalytic reforming units? In other units such as thermal cracking and crude units?

Maddocks: This is part of a broad subject associated with hydrogen sulfide corrosion, hydrogen attack, and the problem of subjecting metals to alternate oxidizing and reducing atmospheres. In the past year, there has been a great deal of information published on this subject, and the protective use of various materials such as

aluminum coatings, the use of higher alloys, the use of clad alloys and the like.

Because this is such a broad subject and could not possibly be discussed in detail here, I would like to make mention of several articles. One is a paper presented to the National Association of Corrosion Engineers at a recent annual conference titled, "Collection and Correlation of High Temperature Hydrogen Sulfide Corrosion Data," by S. G. Sorel and Mr. Hoyt, both of the Kellogg Company. Information is given about the uses of various safeguards—18-8 and alloy liners—and more particularly in answer to the question here—the use of aluminum coatings.

Another paper appearing in the March, 1956, edition of the *Petroleum Refiner* titled "What causes hydrogen attack?" is a descriptive article on the causes of hydrogen attack, blistering, etc., and possible solutions to such problems. I think it is much better to refer to these papers than to try to review completely the subject at this moment.

? Platformate water content: What is the upper limit for water content in the feed to Platformer? Is there any correlation of loss of Platformate yield with increasing hydrogen sulfide content of recycle hydrogen?

Mr. Houser

Houser: In the feed to our Platformer, we have operated for certain periods of time with water content in the 20 to 60 parts per million range. As far as we have been able to determine, there has been no permanent catalyst damage. However, it has been very troublesome because a rather high rate of chloride make-up has been required, and this magnifies corrosion problems in the fractionation section. We have also experienced plugging in the fractionation section as well as the corrosion problems.

Wheeler: Dave Thornton, can you add anything to that?

Thornton: The octane ratings you wish to secure in the Platformate determine how much water can be tolerated in the feed. A small amount of water will have no appreciable effects. As Mr. Houser has pointed out, you may have to correct your acid medium. If high octane numbers are desired, it's advisable to limit water to the greatest degree that you possibly can.

? Chlorides in catalyst: What is the effect of chloride content or chloride addition on the following: susceptibility of catalyst to poisoning by metals, catalyst life, product yields? How is the catalyst chloride content controlled when the feed contains excess chlorides?

Logwinuk: The chloride supplies the so-called acid function to the catalyst; that is, it promotes the dehydroisomerization, and the catalytic cracking reactions. It's desirable, therefore, to have this chloride present. Chloride has no apparent effect upon the dehydrogenation reactions of the reforming catalyst, and as yet we've found no evidence to indicate any increase or decrease in susceptibility of the catalyst to poisoning by metals.

The catalyst life, of course, is prolonged if chloride is present. This is because it's not necessary to reform as severely to achieve a given octane since the dehydroisomerization and the catalytic cracking reactions are promoted. The product yields, of course, are affected by virtue of the promoted dehydro-isomerization reaction, which converts the naphthenes to a greater extent to aromatics than if chloride were not present. Excessive chloride content may be controlled in special cases by controlled moisture injection, or by permitting the feed to enter wet.

Thornton: The chloride content is necessary, in other words, to maintain the activity of the Platforming catalyst which, in turn, materially affects both catalyst life and product yields. If chloride content is excessive in the feed, there is only one thing to do and that is to get it out of there by suitable pretreating. Otherwise, if chlorides are already on your catalyst, you must wash them out.

? Hydrogen blistering: Is hydrogen blistering in catalytic reformers a serious problem? What metal alloys and/or operating techniques are most successfully used for its control?

Haig: I think we were probably the last ones to learn the hard way on this. We certainly had trouble with hydrogen blistering in one of our units. I think we would have been all right at the design metal temperature in the reactor shell itself—it was a carbon steel shell, with an insulating refractory lining. But hydrogen penetrated back there, and to such an extent that there was a warm hydrogen stream passing by the shell at all times in spite of the vapor stops. We definitely got a hydrogen blistering problem.

The way we're getting out—I think it has been done by many others before—is to put in a thin 18-8 liner sealed at the top so that the hydrogen can't get past. There is no pressure drop to drive the hydrogen back into the insulation and along the shell. All the pressure drop is taken across the bed. The hydrogen at the bottom can still work back behind the liner, but it's generally stagnant and cool.

Wheeler: Bruce Jones, I think you had some problems in your fractionation section?

Mr. Jones

Jones: That's right, Harry. During the first year of our Platformer operation, we had some hydrogen blistering on our stabilizer overhead receiver and condenser shell. As a result of this corrosion, we had to build up these corroded parts with weld metal. We went then to the injection of ammonia into our stabilizer in combination with Petromeen—ammonia to neutralize the acidic constitutents and the Petromeen to build a protective film.

We have been using this system now for about a year, and we have not had anything like the magnitude of difficulties encountered during the first year. In fact, we were down just last week with our Platforming unit to renew the catalyst, and made a thorough inspection. Everything appeared in very good condition.

We have also had corrosion difficulty with a carbon steel pressure control value in the stabilizer off-gas line.

and we replaced that with a monel valve at the end of the first six months. It has now been in a year or 18 months, and has stood up very well. We also have successfully used block valves made out of Alloyco 20 in the same stabilizer off-gas piping system. Any place where we have pressure drop, such as an orifice plate, control valves, or even a block valve, we have gone to either monel or Alloyco 20 and we have had good service for at least a year.

Wheeler: Does anybody else have anything on hydrogen?

Mr. McGregor

McGregor: I believe that during the war refineries experienced a lot of hydrogen blistering and fissuring in the overhead line of the syn tower and in the condenser on fluid catalytic crackers or TCC units. One way they overcame this was to inject some boiler feed water above the overhead condenser. It settled in the accumulator and was removed in a water draw-off stream. Enough boiler feed water was added to keep the water draw-off at a pH of 7. You have to be careful of this, because if you have bimetallic tubes in your overhead condenser, the alkaline boiler feed water may work on them.

Mr. Bochow

Bochow: I might add that we use a similar system on our cat cracker. We actually water wash in three different places with the same water. We start out with high pressure water from our poly unit water wash tower and inject it into our compressor after-cooler in the vapor recovery unit. The water then goes into the stripper charge drum where it is drawn off and pressured into the overhead condensers of our main column on the cat unit. The water then goes to the main column receiver where it is drawn to sewer. To date, we have had no trouble with hydrogen blistering, although we haven't inspected that unit for about 20 months.

Logwinuk: I might point out that in moving bed operations we have never encountered any hydrogen blistering in a gas plant whatsoever.

? Reaction chambers: What is the advantage of the multiple reaction chambers versus a single chamber operation? Why is there a trend to make all reactors the same size?

Logwinuk: The ideal system for reforming would be isothermal operation. Commercial reformers, however, are adiabatic units. Hence, during the reforming operation, a considerable temperature drop, depending upon naphthene content of the feed, occurs in the first reactor. Associated with the temperature drop is a decrease in the reaction rate, usually to an undesirably low value. When this occurs, the hydrocarbon is reheated and passed through a second reactor where a smaller temperature occurs.

Then, this is repeated through a third heater and reactor. By this means, we are approaching isothermal conditions. Some stocks, with low naphthene content, may be processed in a single chamber.

To summarize, it may be said that a multiple reactor system is advantageous only in that it permits the approach to isothermal operation. Its disadvantage, of course, is the cost.

I do not believe there is a trend toward making the reactors the same sizes. However, on swing type regenerative units, the same size reactors are being used for conformity of operation, thus permitting the chambers to be operated in any sequence.

Mr. Haig

Haig: It's not just for conformity or for a neat design. Both Indiana's Ultraformer and our Powerformer usually consist of five reactors of the same size with four on stream at any one time. The reactors are regenerated in sequence rather than shutting the entire plant down and regenerating all at once. So when you pull one reactor out of line, you replace it with this fifth reactor or the swing reactor. I think it is obvious in this type of operation that you want to have your reactors the same size, so that your swing can replace any one in the chain and still get steady octane number and yields.

? Sulfur in feed: What is the effect of sulfur in the feed on the following: coke deposition, activity maintenance, initial catalyst activity, catalyst life, and product distribution?

Mr. Logwinuk

Logwinuk: We have always taken the stand that because most charge stocks will have to be treated for the removal of contaminants and poisons, sulfur should be removed simultaneously in a one-step operation. As as result of pretreating the reformer feed, we have not had any experiences showing the effect of sulfur on our commercial reforming operations. Based on commercial experiences of others and our own laboratory studies, it may be pointed out that sulfur causes reforming catalysts to lose activity. This is evidenced by decreasing octane numbers at constant operating conditions.

Prolonged exposure to high sulfur partial pressures also affects the selectivity, resulting in a decrease of C_5 liquid product and an increase in C_4 and lighter materials. Sulfur poisoning is cumulative and irreversible. A catalyst partially deactivated by exposure to a high sulfur stock will not regain activity by switching to a low sulfur stock; further decline, however, will be arrested.

Mr. Thornton

Thornton: I might add a couple of points. On the startup of a unit with fresh catalyst, we prefer to have approximately ten grains of hydrogen sulfide in the recycle gas to "take the edge" off of the extremely active catalyst. As the operation continues, we would prefer to have this concentration gradually drop to

Mr. Wheeler

a level of approximately two grains by the end of the first three or four weeks. It's not advisable to allow sulfur to go above ten grains, because then you start losing your C_5+.

And if you go to levels higher than 20 to 30 you may damage the catalyst. Other than that, I think I will go along with Alex's comments.

Wheeler: In other words, the effect of sulfur is to get it out of there—nobody seems to want it in his reformer charge stock.

Alex, how about you and Dave working on the next question.

? Feed stock preparation: What has been the experience of those operating cat reformers with the use of a filming amine corrosion inhibitor in feed stock preparation equipment with and without a feed pretreatment section on the reformer, regarding catalyst poisoning from the nitrogen content of such inhibitor?

Thornton: The only comment I can make on that is that any time you put nitrogen into a cat reformer using a platinum containing catalyst, there will be an adverse effect on catalyst activity and product quality. The effect usually will be temporary and you can compensate for it by boosting operating temperatures. But there's a practical limit to how much compensation can be secured in this manner. My recommendation is: Don't put an excessive amount of nitrogen compounds in a cat reformer.

Killen (Standard of Ohio): We have used an amine in ours—but we do have a pretreater. The amount that you have to put in for corrosion resistance is very small. It's broken down in the pretreater and goes off as ammonia. We haven't experienced any trouble in using normal injection rates for that type inhibitor.

Wheeler: Are you using it as a corrosion inhibitor in your pretreater?

Killen: Well, actually we've been using it in the pretreater to prevent fouling, rather than corrosion.

Logwinuk: If you're using it in the pretreater, you're most likely taking out any ammonia in your stripper.

Killen: That's right.

Logwinuk: It actually doesn't get over to your reformer.

Killen: It wouldn't get to the reformer. It would be a different case if it did, although even there the amount is rather small. You're putting in maybe three, four, six ppm on feed so the amount you have in the reformer is quite small. You can compensate for the NH_3 with temperature if you need to.

Thornton: One more little comment. That is, if you are using, as a feed pretreater, a Unifining unit, I doubt that you'd need any amine treatment for corrosion resistance and you certainly would not need to worry about nitrogen compounds getting to your catalyst. You've gotten most of the potentially corrosive materials out in Unifining. A lot of possible trouble can be taken care of by suitable metallurgy in pretreater equipment items.

Wheeler: Are there any more questions from the floor on catalytic reforming?

Killen: Going back here to this first question—we discussed this a little bit but I didn't get the questions in my mind answered and maybe somebody here can answer them. We feel that chloride and water are more or less interchangeable with temperature as far as making octane goes. We inject both at various times, but we aren't satisfied that we always know what the optimum is. Should we get our octane with temperature; or with water and chloride; or with just chloride; or with more water and less chloride? There are three inter-related variables there and we haven't been able to tie down the optimum way to operate. I think it changes as your catalyst deactivates and I wondered if anybody else had any experience along that line.

Wheeler: What kind of a unit do you have?

Killen: It's a Platformer.

Thornton: I think you have to make a very careful engineering study before that question could be answered, and I wouldn't want to attempt to answer it here.

Killen: Well, there was one here I'd like to hit you with again that we missed. Maybe Dave Thornton could answer, maybe somebody else and that is:

? Evaluating catalyst life: Has anyone come up with a good quick way to evaluate in the pilot plant the effect of various factors on catalyst life? This, of course, would be on a nonregenerative process.

Wheeler: We had quite a discussion on that at lunch. The reason we haven't brought it up is that nobody's come up with a good quick way to evaluate catalyst life. In fact, I think the general problem of evaluating catalyst life just hasn't been solved. I don't think they even know a good long way to do it.

Killen: That's just about been our experience, I'm afraid.

Thornton: We would probably evaluate it about the same way you do in your unit, just run it.

Killen: It comes out to be a pretty short way, sometimes, that's the trouble. I think a little might be added to the answer to Homer White's question on the effect of end point. We definitely do find catalyst life shortened with the higher end point feed but at the same time we are making high octane relatively easily from a lower octane stock. So, it's a case probably of whether you have an excess of feed or a shortage of feed. If you're short of feed, you probably want to charge that naphtha up to 400 E.P. anyway; but if you have more feed than you can use, you'll get a lot better life if you'll cut the end point as low as you can.

The next installment . . .

More on Catalytic Reforming Problems

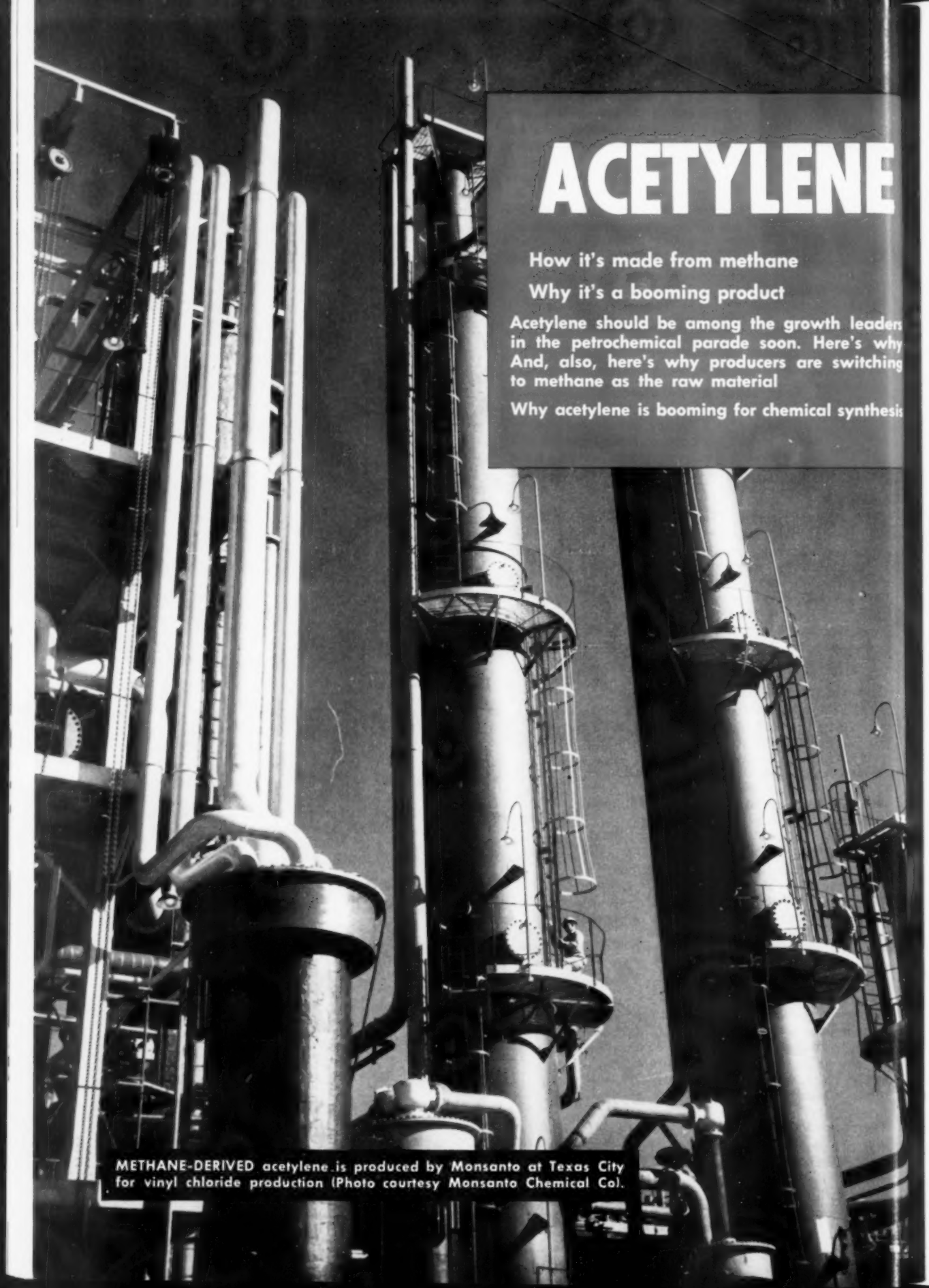
ACETYLENE

How it's made from methane

Why it's a booming product

Acetylene should be among the growth leaders in the petrochemical parade soon. Here's why. And, also, here's why producers are switching to methane as the raw material

Why acetylene is booming for chemical synthesis



METHANE-DERIVED acetylene is produced by Monsanto at Texas City for vinyl chloride production (Photo courtesy Monsanto Chemical Co).

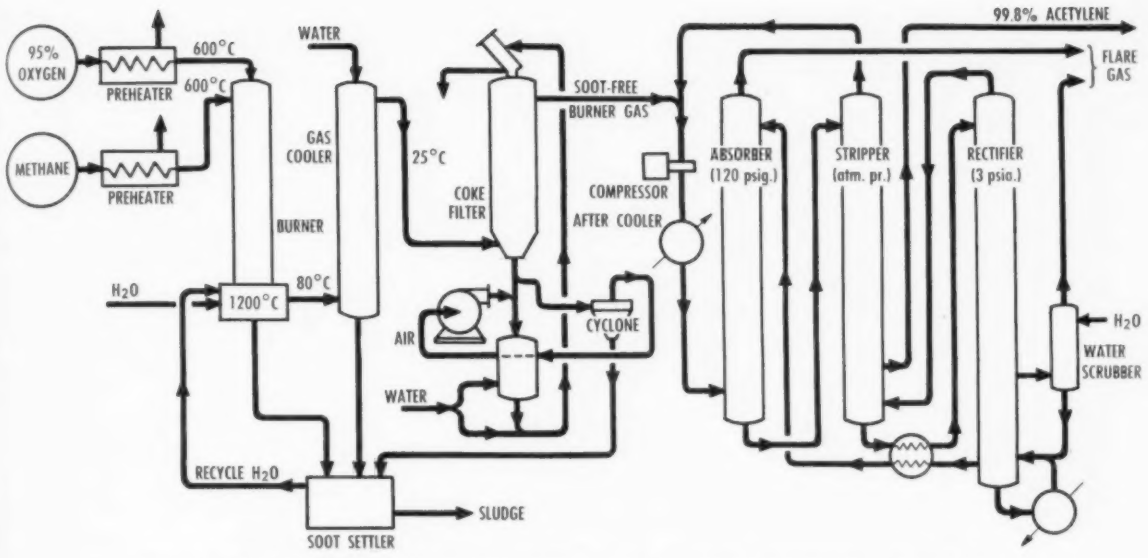


Fig. 1.—**BASF PROCESS** for acetylene production by partial combustion of methane

TO PRODUCE acetylene from hydrocarbons, highly exothermic reaction heat must be supplied rapidly. Excluding the future possibility of a nuclear heat source, there are three methods for imparting the needed heat to the process gas: 1—use of electric arc or spark; 2—regenerative means in which the process gas is brought into contact with preheated surfaces; 3—partial combustion, where the hydrocarbon gas serves partly as feed gas and partly as fuel.

An electric process has been operated commercially at Huls, Germany, for over fifteen years now. Several parallel approaches have been investigated in the United States, but none has found commercial application.

High-temperature regenerative cracking processes are capable of yielding both ethylene and acetylene. The ratio between these two products is adjustable within wide limits. Phillips' new installation at Sweeny, Texas, will use the regenerative approach in which a continuous pebble furnace (operated on the thermofor principle) will most probably serve as reactor. An alternative, cyclically operated regenerative furnace is the heart of the Wulff acetylene process, which has commercial potential.

Partial combustion processes, however, have been the center of most activity. This is the approach used by Monsanto and by Carbide & Carbon. Chemical Construction Co. claims [3] that it will have engineered and built 150 million lb/yr of acetylene capacity by 1957, using the partial combusion process (this includes American Cyanamid's Fortier plant).

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In Europe, too, several partial combustion installations have been built for acetylene generation. Among them we might mention the plant of SISAS near Milan, the ACSA unit near Venice, and Montecatini's installation at Novara.

Partial combustion then, is the approach that has made the greatest industrial headway for acetylene generation from light hydrocarbons.

The partial combustion process

Acetylene synthesis is possible from a wide variety of hydrocarbons. Because of economic considerations, however, methane is universally used as starting material in the partial combustion process. This discussion will be confined to this feed gas. It should be mentioned, however, that thermal pyrolysis processes, in which ethylene and acetylene are intended co-products, look to ethane, propane, and butane for feedstocks.

Overall, the formation of acetylene from methane is brought about in accordance with equation (1):

$$2CH_4 \rightarrow C_2H_2 + 3H_2 - 95.5 \text{ Kcal (at } 1500^\circ \text{ C)} \quad (1)$$

Acetylene formation below 700° C is quite insignificant. With rising temperature, the equilibrium of this endothermic reaction shifts rapidly to the right. Substantially maximum acetylene formation is reached at 1400-1450° C. Above this level, little can be gained by further increase in temperature. Limiting theoretical conversion of methane to acetylene is about 25%.

At the required high pyrolysis temperature, breakdown reactions destroy acetylene rapidly. It is, therefore, necessary that the time of high-temperature exposure be held in the optimum range 0.003 to 0.01 seconds.

In the partial combustion process, gaseous oxygen is introduced together with the feed methane. This serves to burn a portion of the methane in order to raise the process gas to the required temperature and to supply the heat required by the endothermic pyrolysis reaction [1]. In the operating temperature range, combustion leads principally to carbon monoxide, with only lesser CO_2 and H_2O formation.

Some work has been directed to the use of air as oxidizing agent. Practical considerations, however, call for the use of concentrated (95-98%) oxygen. There are two basic reasons for this: 1—to reach the needed flame temperatures with air, methane consumption would become excessive; 2—the product gases from air combustion are so dilute in acetylene content that recovery costs overburden the process economics.

Several commercial partial methane combustion processes have been developed: their chief differences are details of burner design and recovery system. One partial combustion method, developed by Belgium's Société Belge de l'Azote has recently been licensed to Blaw-Knox Co. [13] However, at this writing, the predominant commercial partial methane combustion process is the one developed by

BASF (Germany) and licensed in the United States to Chemical Construction Co. See Fig. 1.

Process flow

The feed natural gas should be substantially free of hydrogen and carbon monoxide, which bring a very real danger of pre-ignition. Oxygen is at 95% purity, i.e., the grade obtained by the so-called "tonnage oxygen" processes. The oxygen:methane ratio must be carefully controlled. Optimum is somewhat less than 0.65.

The two feed gases are separately preheated to 600° C. The streams are joined in a specially designed mixing zone atop the burner in which the reaction takes place. After passage through the reaction zone proper in the burner, the process gas is quenched by injection of water into the burner's lower section. The gases leaving the bottom of the burner at approximately 80° C, have the following typical composition on a dry basis (14):

Acetylene	8-9%
Carbon dioxide	3-4
Methane	6-7
Carbon monoxide	24-26
Hydrogen	56

The remainder consists mainly of higher hydrocarbons (including 0.1-0.2% diacetylene) plus some nitrogen and argon.

The burner gas is further cooled in a water-scrubbed tower and goes from there to the purification section.

In the course of the burner reaction, 0.5-1.0 lb of soot is formed per Mcf of feed gas. About one-third of this is removed with the quench water. The remainder is eliminated in a special soot filter in which the gas is passed through a countercurrently moving bed of coke. Residual soot content is 0.1 mg/cu ft[4].

The cleaned gas is compressed to about 105 psig. Following after-cooling, it is taken to an absorption column in which more than 99% of the contained acetylene is taken up in a water-soluble organic slovent (see below). Off-gas from the absorber is rich in carbon monoxide and hydrogen, and is potential raw material for various chemical syntheses.

The rich liquor is taken to a stripper column operated at atmospheric pressure. Some acetylene is fed to the bottom of this stripper to displace contained gases of lower solubility (especially CO_2). These latter components are taken off overhead and are recycled to the absorber column. Product acetylene is withdrawn from the stripper as a side-stream near the bottom. Its purity is over 99.8%.

The lean liquor, leaving the stripper bottom, contains some acetylene as well as its higher homologues, (especially diacetylene) which are more soluble in the medium than is acetylene itself. These components must be removed from the system to prevent build-up and resulting contamination of the product, and also to avoid the polymerization to which diacetylene is particularly prone.

The separation of these contaminants from solvent and acetylene is brought about in a final rectification column. This tower is operated at 3 psia, with bottoms temperature above 100° C. At these conditions, the organic solvent itself will not boil but the contained water acts as stripping agent for the contaminants that are removed as side stream from the column's lower section. Acetylene entering the rectifier in solution is removed at the tower top and recycled to the bottom of the stripper column. Overall acetylene recovery is nearly complete.

The side-stream of the rectifier, which contains diacetylene and other acetylene homologues, is washed with water for recovery of contained vaporized solvent. The resulting aqueous solution joins the main solvent stream en route to the absorber column.

Commercial experience shows the following raw materials consumption per pound of 99.8% acetylene as typical of the process [4] cf. also [5 and 14]:

Natural gas (for synthesis, drives and preheat)	116 SCF
Oxygen (95% basis)	5.2 lb
Electric power	0.17 kwh
Steam	13.3 lb
Cooling water (of which 70% is HP steam)	140 gal.

Each pound of acetylene yields 180 SCF of off-gas that contains nearly 90% carbon monoxide plus hydrogen, as well as about 4% methane. The value of this by-product depends on its end use. Its fuel value is about 325 BTU/SCF or 60,000 BTU for every pound of acetylene produced. But its real attraction rests in the contained carbon monoxide and hydrogen that may be upgraded to the feed specifications of various processes requiring such synthesis gas (methanol, ammonia, OXO, etc.)

Burner design problems

The methane-oxygen burner, together with its gas mixing zone, is the heart of the process. Several specific major engineering problems had to be overcome before the partial combustion process could become a commercial reality. They were:

1— Design of the methane-oxygen mixing zone to minimize the possibility of flame formation at mix temperature of 600° C.

2— Introduction of the reaction mixture into the burner zone without causing pre-ignition.

3— Ignition of the mixture in the burner proper to form a stable and stationary reaction zone.

4— Quenching the burner gases following the short permissible contact time.

Several feasible solutions to these problems are discussed below with special emphasis on the approaches used in the BASF process that has already demonstrated its success.

1—Design of mixing zone

The oxygen:methane ratio fed to the burners is approximately 0.65. For reasons of thermal and materials economy, the two feeds are preheated separately to 600-700° C. Upon mixing, we shall have a mixture that is

Why acetylene

ALL SIGNS point toward acetylene as a leading growth raw material of the petrochemical industries' next decade. The three key factors are: 1—development of new low-cost acetylene-producing processes, based largely on petroleum hydrocarbons as starting point; 2—a trend toward large-size plants, capable of turning out acetylene at low unit cost; and 3—accelerated expansion and interest in the many acetylene-derived chemicals.

The result is a definite uptrend in the long-range outlook for acetylene. A recent estimate[1] forecasts 1961 acetylene consumption for chemical syntheses alone at 840 million lb, 77% above the approximately 475 million lb consumed in 1956. This is an annual growth rate of 12%, compared to an average rate of only 7% during the years 1946-1955.

As little as fifteen years ago, the bulk of acetylene was consumed for welding purposes. Today, this outlet constitutes only some 20% of the total, and its share continues to decline as chemical synthesis takes on a role of increasing significance as acetylene consumers.

At this writing, the principal acetylene consumers are neoprene, vinyl chloride, tri- and perchloroethylene, vinyl acetate, and acrylonitrile, in the order stated. Other

is booming in chemical synthesis

How much acetylene some products use

(million lb/yr)

	1951	1956 (est'd)	1961 (forecast)
Neoprene	92	158	230
Vinyl chloride	90	146	260
Tri- and perchloroethylene	64	76	88
Vinyl acetate	33	44	78
Acrylonitrile	None	35	122
Acrylates, methyl styrene vinyl esters, etc.	3	15	65

derivatives of importance include acrylates, 1, 4-butanediol, methyl styrene, vinyl esters, polyvinyl pyrollidone, and a host of comers. Of historical interest is the use of acetylene for acetaldehyde production, which was a significant factor (app. 10% of acetylene consumed) in 1949. This process is today practiced only outside the United States (notably in Canada, England, and Germany).

The trends in consumption of acetylene by its major derivatives are illustrated by data from Musser and Walker[1] in table above.

The growth outlook for acetylene utilization in vinyl chloride and acrylonitrile production is most strongly influenced by alternative routes. Somewhat more than 40% of vinyl chloride production is obtained from 1, 2-dichloroethane, an ethylene derivative. The relative economics of the two routes to vinyl chloride are dependent on local factors and on the value of by-product HCl obtained in the dichloroethane route. It is unlikely that the acetylene route's share of total vinyl chloride production will deviate significantly from its present 60% during the next few years. The growth of this use for acetylene should, therefore, parallel the expansion rate of vinyl chloride itself, which is estimated at 10-12% per year[1].

An entirely different picture obtains in acrylonitrile synthesis. As recently as 1951, all production was based on ethylene oxide and hydrogen cyanide. Today, some 50% of acrylonitrile production uses acetylene as starting material. The economics for the newer route are more favorable, especially in the large manufacturing units that must be built to cope with the very rapid current growth of acrylonitrile. It is probable that all new acrylonitrile capacity will be based on the acetylene process.

That such expansion will be significant is certain. Acrylonitrile serves as one monomer in the production of widely heralded synthetic fibers and for several new types of plastics. In addition, its market in nitrile rubber production continues to expand, though the importance of this outlet is being rapidly overshadowed by the newer uses. Growth during the years 1951-1956 has been at the average rate of 50% per year, conservative estimating places future expansion rate at 15-20% annually.

Expansion of the other three principal acetylene consumers will be substantially paralleled by an equivalent increase in demand for acetylene.

In the case of neoprene, today's largest chemical consumer of acetylene, future growth will have to meet the competition of improved grades of less costly synthetic rubbers. Despite this competition, Musser predicts a 45% growth for neoprene in the next five years.

A smaller expansion rate is foreseen in the use of trichloroethylene, and its derivative perchloroethylene. Both find their principal use as industrial solvents. Use of acetylene in the production of these commodities should rise about 25% between 1956 and 1961.

A healthier expansion rate is anticipated for vinyl acetate. This monomer is produced by the reaction of acetylene with acetic acid. Much of its potential growth is expected from increased use of polyvinyl acetate in latex paints. But other current uses for polyvinyl

Continued on next page

in the explosive range. Steps must, therefore, be taken to avoid the ignition of the mixture before it enters the reaction zone proper.

Three factors may contribute to pre-ignition in the mixing chamber: 1—flame may strike back from the reaction zone. 2—Induction may occur spontaneously in the mixing zone, and 3—the presence of iron oxide or other particles may catalyze the reaction.

To prevent flame strike-back, the reaction area proper is separated from the mixing zone by a burner block that acts as flame arrestor. Considerations in its design will be set forth below. If properly designed, this burner block can completely prevent flame strike-back as long as gas velocity is high enough.

More difficult is the problem of self-ignition. It has been determined that the combustion of methane-oxygen mixtures is preceded by an induction period that depends on the temperature. Thus, at 600-700° C, several seconds are available to effect the mixing of the feed components. Even at 850° C, the induction period is slightly above 0.1 seconds.

It must be emphasized that we are here not dealing with average contact times but with contact time for any given volume of gas mixture. The mixing zone must be carefully designed so that the residence time at any point in the mixing zone is less than the induction time of the methane-oxygen reaction.

According to a BASF patent [6], oxygen is brought into the methane stream through a tube located concentrically in the upper narrow part of the mixing chamber. Below this point the chamber is enlarged conically until the required diameter of the burner zone is reached. The length of the mixing zone should be at least three times its maximum width. The mean speed of gases at their junction point should be at least 215 ft/sec, measured at 0° C and 760 mm. Care must be taken that the two reactants are introduced at equal pressure[7].

The third cause of pre-ignition is the presence of catalytic particles, such as rust carried in with the feed gas. Despite all reasonable precautions, this is unavoidable. Occasional pre-ignition will, therefore, be observed. The problem is to localize the occurrence and carry flame, once formed, immediately into the reaction space proper; i.e., the flame must be unstable in the mixing zone.

The danger of flame stability is greatest at the point of gas juncture where the entire range of gas compositions is encountered, including that with the highest flame velocity [5]. For this reason, a particularly high linear gas velocity must prevail near the mix point, which led to the conical designed mix chamber.

Why acetylene is booming in chemical synthesis (continued)

acetate and for VA-derived polyvinyl alcohol, polyvinyl formal and polyvinyl butyral are co-responsible for the expected 80% expansion in vinyl acetate's production during the next five years.

In a long-range assessment of acetylene's potential, it's necessary to consider numerous other derivatives, some of which are only today entering commercial production while others are still in research and development stages. It is certain that development in these new acetylene markets will have very major impact on future acetylene utilization, but the pattern has not yet emerged clearly.

A first step in this field was taken by Rohm and Haas Co. in 1953 when it began commercial manufacture of acrylates from acetylene, carbon monoxide and methanol, thus providing a successfully competitive method for the conventional acrylate synthesis from ethyleneoxide and hydrogen cyanide.

General Aniline Film Corporation's new plant at Calvert City, Ky., began in 1956 to produce a whole new line of acetylene derivatives. Among its products are polyvinylpyrollidone (a blood volume expander and pharmaceutical synergist), propargyl alcohol (intermediate for vitamin A, polyurethanes), butanediol, butynediol, and butyrolactone (acetylene solvent, intermediate for pyrollidone).

Acetylene-derived vinyl ethers, which are also produced at GAF's Calvert City plant are monomers of potential interest in the manufacture of elastomers, adhesives, and textile finishes.

Among other promising acetylene products still in the developmental stage we may include tertiary acetylenic glycols, vinyl stearate, and alkali metal acetylides. Some observers also predict emergence of a new branch of organic chemistry based on acetylene-derived cyclooctatetraene.

Some of these outlets are still a long way off, the potential of others is probably overrated. But the general level of commercial and research activity in the field of acetylene chemistry assures that acetylene will be one of the two or three most important growth chemicals of the next decade.

At this writing, 85 to 87% of the nation's acetylene supply is still derived from calcium carbide, the conventional source. Only three operating plants base their acetylene production on hydrocarbon pyrolysis. It is believed that their entire output goes into two products: Vinyl chloride produced at Texas City by Monsanto Chemical Co. and Carbide & Carbon Chemical Co.; and Acrylonitrile produced by American Cynamid Co. at its new Fortier, La., installation. At all three of these plants, acetylene is obtained by the partial combustion of methane.

Other manufacturers are also turning to methane pyrolysis for their acetylene supply. One such unit it now under construction at Rohm & Hass' Houston, Texas plant where the product will replace the present calcium carbide-based acetylene supply for acrylate esters synthesis.

Another methane-based acetylene plant is being built at Dow Chemical Co.'s Freeport, Tex., plant where the product will be converted to vinyl chloride. This is also the end use intended for acetylene that may be produced at Houston, Tex., under plans recently announced by Diamond Alkali Co.

A different approach to petrochemical acetylene production is being taken at Carbide & Carbon's Torrance, Cal., plant. Here, refinery gas is cracked to make ethylene. By-product acetylene is recovered and bottled for welding purposes.

Co-production of ethylene and acetylene is also the course chosen for Phillips Chemical Co.'s hydrocarbon pyrolysis plant now under construction at Sweeny, Tex. At Carbide's and at Phillips' plants, the primary emphasis is on ethylene, however, with acetylene produced on a much smaller scale.

This emphasis is reversed at Wulff Process Company's Los Angeles,

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2—Introduction of mixture

The mixing zone is separated from the reaction area by the burner block through which narrow parallel gas passages are provided. This burner block has two important tasks: 1—to prevent flame-back into the mixing chamber, and 2—to carry the feed gases into the burner zone in a way that permits stability of the flame.

The first objective is achieved by sizing the passages in the gas so that the gas velocity exceeds the flame velocity in the methane-oxygen mixture.

As the gas leaves the burner block passages and enters the reaction zone, it must be ignited, and should burn in a flame that is stable and substantially at right angles to the gas flow. Only if these requirements are met, will there be sufficiently uniform conditions throughout the burner to permit control of the reaction zone to optimum yield.

Flame stability can occur only if the linear speed of the entering stream is less than the flame's extinction velocity, i.e., the velocity at which the flame is lifted away from the burner block and is finally blown out. This extinction velocity is a function of the diameter of the feed gas pipe—i.e., the passages through the burner block. Data for the combustion of methane [8] show a rapid decrease in extinction velocity as the feed tube diameter increases from very small size. Above a 10 mm diameter, the tube opening is of less influence; extinction velocity becomes assymptotic at 33-35 ft/sec.

In the early burner block designs, gas passages were accordingly held to 10 mm diameter maximum to permit flame stability as well as to prevent flame-back. More recently, Sachsse has claimed [9] the feasibility of passages up to 35 mm diameter by providing internal distributors that cause a spiral movement of the gases.

The chief advantage of the wider tubes is a longer burner block life because the small passages are readily eroded and obstructed by soot. For otherwise similar conditions, Sachsse cites a 6-week life for a block with 10-mm passages and a 4-month life in the case of 20-mm channels.

3—Ignition and flame

In the reaction space, the gas velocity must be below the flame velocity to avoid extinction. Fortunately, this flame velocity is very high at turbulent conditions (at laminar flow, it is only about 120 ft/sec) so that high gas rates are also possible.

Flow turbulence in the burner zone has two further advantages: it enhances the heat transfer between flame and entering gas, thus facilitating ignition; and it results in a flame of nearly uniform thickness throughout the diameter of the reaction space, a

Cal., demonstration plant. Here, acetylene is produced by hydrocarbon cracking; the product is bottled and sold. The off-gases contain ethylene which might be profitably recovered in a larger plant.

Indeed, plant size is the key to economic acetylene production from petroleum sources. For small installations, the calcium carbide route continues to be more economical. Just where the breakpoint is depends on local factors. In the Gulf Coast area, a 10-15 million lb/yr plant should yield acetylene from natural gas for about the same cost as from purchased calcium carbide. In areas of high gas price and low electrical and coke cost, the carbide process holds the advantage, almost regardless of plant size. Thus, capacity of the world's largest acetylene plant, located at Calvert City, Ky., exceeds 200 million lb/yr, produced entirely from captive calcium carbide.

It must be pointed out that the large capacity expansion of current years takes place despite the availability of large overcapacity (installed carbide capacity was employed to the extent of only about 60 in 1956). The reason for this apparent paradox is to be found in the competitive aspect of acetylene production as well as in the shift in utilization pattern, which voids old geographic distribution requirements.

condition desirable from acetylene yield considerations. The thickness of flame is set at a permissible maximum of 200 mm.

Existing plants have a throughput of 60,000 scfh methane per individual burner. Judging by data from Sachsse [8] and Bartholome [5], the burning zone in units of this capacity has a circular cross-section of 1 ft 2 in diameter. With a flame thickness of approximately six inches, this calculates to an actual residence time of 0.003 seconds at 1200° C.

Mention should be made of several proposals for igniting the gas mixture (especially air-methane mixtures) by the injection of hydrogen at a point immediately following the burner block, or its equivalent in alternative designs. This variation sidesteps some of the design problems outlined above, but it does so by introducing new complexities. No commercial exploitation of this principle is known to the writer.

4—Quenching the burner gas

In order to minimize product-consuming degradation reactions, the hot gases must be quenched immediately upon issuing from the burner zone. In present commercial installations, such quenching is provided by injection of water into the hot gas stream. Water must be injected in small droplets so that their large surface permits rapid evaporative cooling. However, if the spray is too fine, it will not have enough kinetic energy to reach the center of the burner gas stream. Thus, an optimum droplet size exists [5] that has been determined experimentally.

Injection of finely divided solid particles as a quenching agent has been proposed in various patents. Among the cited materials are aluminum, silica, ferric oxide (which is to be reduced endothermically as part of the quenching action) and activated charcoal. The latter is claimed to decrease the presence of divinyl acetylene in the product, presumably because of adsorption in the course of the quenching step.

Use of fluidized silica for quenching purposes has been investigated [10]. The system is of potential interest. However, in the preliminary reported work, burner capacity was only about one-tenth of that in BASF burners, and the product acetylene was highly diluted by nitrogen, which was used as fluidizing gas.

Systems for acetylene recovery

Acetylene content of the burner gas is only about 8%. Following gas cooling and soot removal, a concentration step is provided. Its efficiency, both in acetylene recovery and compression requirements, is a key factor in the economics of the process.

The early methane pyrolysis plants used water as acetylene solvent in the recovery step [14]. The method called for initial absorption at 160 psig and final degassing at 50 mm Hg. It suffers thus from high power cost. Acetylene losses are appreciable especially in the diacetylene separation stage. Furthermore, water absorption introduces a problem of CO_2 removal.

More recent installations use organic media that are characterized by higher solvent power and greater specificity for acetylene. The flow scheme described above for acteylene recovery covers the absorption-stripping-rectifying cycle used in the BASF process. The solvent used in this process has not been disclosed. Most probably, it is gamma-butyrolactone, containing 2-5% water [11]. This solvent is costly on a unit basis, but its high vapor pressure minimizes losses, and means are available to upgrade butyrolactone, which deteriorates gradually in use. Reported solvent loss per ton of acetylene ranges from 6 lb [4] to 10 lb [5].

A number of other solvents show the physical characteristics required of a suitable solvent for acetylene recovery from partial combustion gases. Among them might be mentioned: dimethyl formamide, glyconitrile, N-formyl pyrollidone, trimethoxyethyl phosphate, dimethyl sulfoxide, phosphoryl trimethyl amide, and acetonyl acetone. Information has become available most particularly on the pilot-plant use of dimethyl formamide for the recovery of acetylene from gases formed by electrical pyrolysis of methane [15]. Interest attaches also to the use of ammonia as acetylene solvent, reportedly [13] the basis for the recovery system of Société Belge de l'Azote's partial combustion process.

Recovery of acetylene from partial combustion gases by adsorption on activated charcoal in a continuous countercurrently moving bed ("Hypersorber") has been described by Berg [16]. The process has attractions, at least as first concentration step, although Bartholome [5] rejects the use of solid adsorbents generally because of the polymerization tendency of acetylene and its higher homologues when adsorbed.

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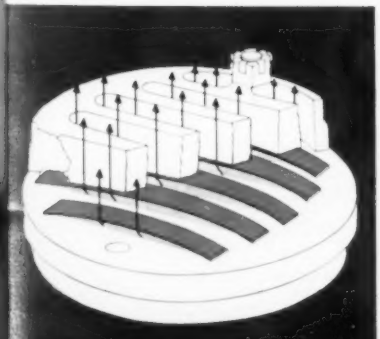

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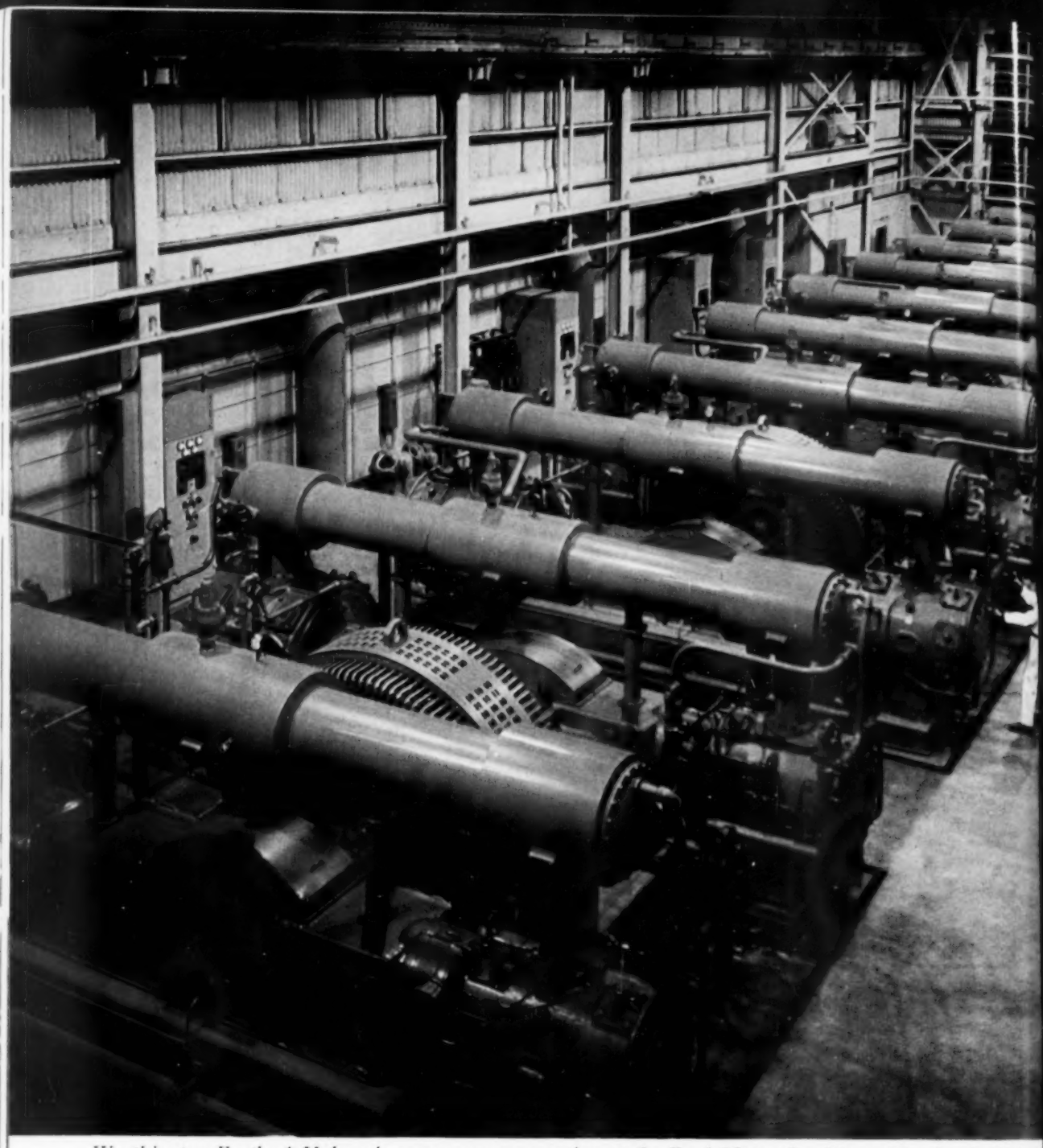

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See preceding page

June, 1957

How to do a better job of

LOW TEMPERATURE INSULATION

Low temperatures mean different problems

Types of insulation materials you can use

Special problems and how to solve them

Correct installation of a complete system

Proper maintenance pays off in long life

A Special Report by ALAN CANNON, Southwestern Editor

Petroleum Processing

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Low temperature insulation pays off

INSULATION of equipment operating at temperatures below 32° F requires materials, methods, and an approach radically different from those required for hot installations.

Some engineers and designers have been fighting the low temperature battle for years, while others have run headlong into it with little or no time to gain respect for new problems.

This report shows basic concepts along with today's practice. It gives recommendations of manufacturers, designers, and contractors. It includes observations of plant engineers with considerable field experience, and others who are still learning (sometimes the hard way).

Too frequently, insulation is overlooked in new design and construction. Many times, in the rush to get drawings off the board, serious thought of insulation requirements and specifications are delayed until "mopping up" stages. They are regarded as a take-off chore instead of an engineering consideration. Too often, application is caught up in a crash schedule to get the new unit onstream or to finish a turnaround.

The success or failure of a reaction or perhaps an entire process, however, could hinge on the effectiveness of the insulation job.

To appreciate the cost involved, consider that most estimators will figure insulation for the average low temperature petroleum processing unit at about 3% of the total job cost. For a $10-million unit, $300,000 is invested in the insulation system.

This is the cost whether the insulation does its job or not. Obviously, a properly designed, properly applied system will pay tremendous dividends.

How low is low?

LOW TEMPERATURE insulation is that type designed for temperatures below 32°F. All thermal insulation can be classified generally into four divisions, according to the temperature ranges involved.

Low temperatures	below 32°F
Lower medium temperatures	32°F to ambient
Higher medium temperatures	ambient to 212°F
High temperatures	above 212°F

Although most plants do not formerly recognize these exact classifications, the specifications they use will reflect in various ways the existence of problems peculiar to each temperature range. Precise dividing lines between the classes will vary with climate and experience.

Some insulation specifications are written for three classes, with the two medium temperature groups lumped into one. In such cases, the lower limit will vary from 32°F to ambient and the upper limit from 212 to 250°F.

Each temperature classification places different demands on the insulation system, regardless of individual cases and specifications. Each requires basically different approaches and concepts. This report will be limited specifically to insulation for temperatures below 32°F.

Low temperature p

THE MAIN JOB of the insulation system is to provide a control of process temperatures. The basic difference between the functions of high and low temperature insulation is in the *direction of vapor pressure* generated by the temperature differential between the insulated body and the atmosphere.

All air has a measurable vapor pressure, governed by its temperature and its relative humidity. In general, the lower the temperature, the lower the vapor pressure. And, the lower the relative humidity, the lower the vapor pressure.

Water vapor in the air is a gas and can penetrate any material that will absorb air. When an insulated body is at temperatures above atmospheric, water's vapor pressure will be higher at the insulated surface than in the surrounding air. Thus, the direction of the vapor path is *outward* through the insulation (see Fig. 1, left). Under these conditions insulation need only be pro-

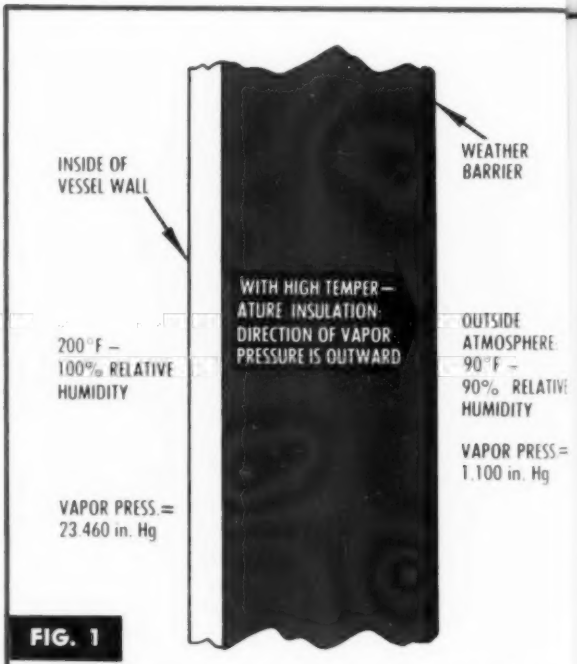

INSIDE OF VESSEL WALL
WEATHER BARRIER
WITH HIGH TEMPER— ATURE INSULATION: DIRECTION OF VAPOR PRESSURE IS OUTWARD
200°F — 100% RELATIVE HUMIDITY
VAPOR PRESS = 23.460 in. Hg
OUTSIDE ATMOSPHERE 90°F — 90% RELATIVE HUMIDITY
VAPOR PRESS = 1.100 in. Hg

FIG. 1

THE MECHANICS OF VAPOR PRESSURE as it affects thermal insulation under typical conditions of high and low temperatures is shown in the above drawings.

Under high temperature conditions (left), the vapor pressure within the insulation is higher than in the outside atmosphere—and prevents water vapors from entering.

Assuming the insulated vessel is operated at low temperature conditions (right), exactly the opposite is true. Vapor pressure in the outside atmosphere is higher than

pose different problems

tected from water in the *liquid phase* with some form of weather barrier. The heat of the insulated body will keep the insulation reasonably free of water in the *vapor phase*.

Where the temperature of the insulated body is lower than that of the surrounding air, however, the direction of the vapor path is *inward* through the insulation, introducing moisture into the insulation material. The two parts of Fig. 1 illustrate this difference between hot (left) and cold (right) conditions.

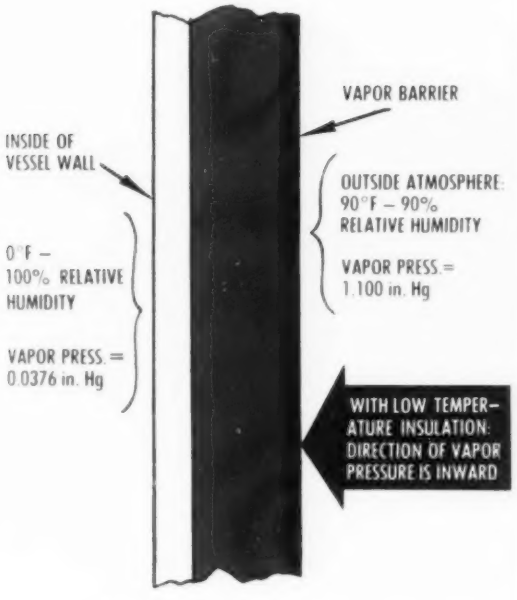
Water vapor which gets into the insulation will condense when cooled to its dew point. If the insulated equipment is below 32°F, at least some of the water will freeze—bursting the insulation and allowing even more water vapor to enter.

These cumulative effects, one pushing the other along, will soon wreck the insulation system within the affected section. The real damage, however, often occurs long before final destruction by icing becomes evident.

Water has a conductivity—"*K*"—of 4.2 at 70°F—about twelve times that of a good insulating material. With no positive force to drive the moisture out of the insulation on the cold installation, the system will lose its insulating effect entirely. The insulation will deteriorate and require replacement.

Icing and water damage may not show up immediately with some of the cellular insulating materials. These materials are impervious and will not absorb water, but moisture that might enter the system through cracks or unsealed joints will damage the insulation in time. Damage from localized frosting or freezing might be minor but when this moisture thaws—as during turnarounds—it must run and collect at some point in the system. Freezing again in larger quantities, the moisture will wreck the affected portion of the system.

In those parts of the low temperature process unit operating at temperatures over 32°F, moisture won't freeze and visible damage may not occur. Moisture will


VAPOR BARRIER
INSIDE OF VESSEL WALL
OUTSIDE ATMOSPHERE: 90°F – 90% RELATIVE HUMIDITY
VAPOR PRESS. = 1.100 in. Hg
0°F – 100% RELATIVE HUMIDITY
VAPOR PRESS. = 0.0376 in. Hg
WITH LOW TEMPERATURE INSULATION: DIRECTION OF VAPOR PRESSURE IS INWARD

in the insulation, and will tend to drive water vapor through the vapor barrier to the cold surface of the insulated vessel. All other conditions remaining the same, this force will increase in direct proportion to the temperature differential between the insulated body and the atmosphere. To this must be added the effects of wind pressure, water in the liquid state, and the immediate surroundings of the equipment (such as spray ponds, hot or cold bodies, or severe climatic conditions).

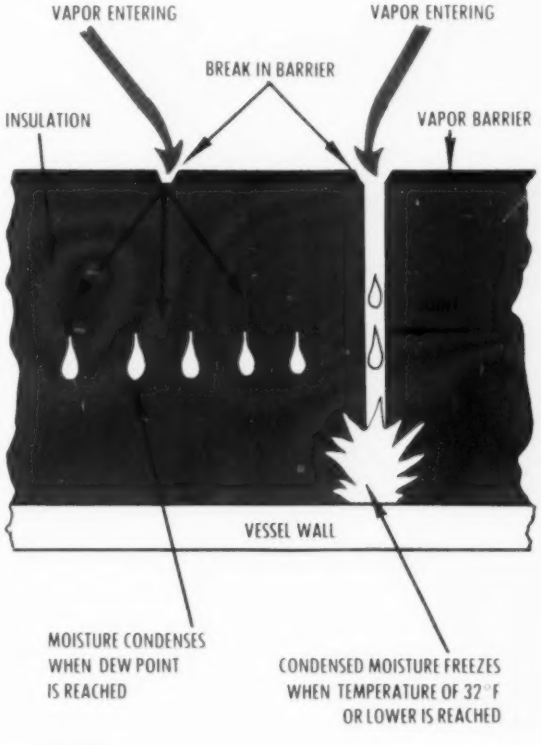


FIG. 2

HOW MOISTURE DESTROYS INSULATION—Water vapor enters through breaks in vapor barrier, is cooled to dew point, and condenses. Freezing of condensate follows, bursting insulation and allowing even more moisture to enter

still collect in these areas, however, and will lead to progressive, unseen metal *corrosion* under the insulation. The resulting damage may be more costly than the insulation failure itself.

Effective low temperature insulation, then, becomes a matter of effective moisture control. Because most insulating materials will absorb water or transmit water vapor, the problem grows in direct proportion to the difference in vapor pressure. This in turn is proportional to the temperature difference between the insulated body and the outside air. Even materials impervious to water and water vapor have joints that must be sealed to stop the passage of moisture.

The burden of moisture control usually falls on the exterior vapor barrier—in most cases a combination of membranes and relatively impervious mastics. The perfect vapor barrier would be a metal jacket, hermetically sealed against moisture—impractical and prohibitive in cost, except for extremely low temperature processes where no other method will satisfy.

Look for these qualities in low temperature insulation

- **Low conductivity.** An obvious quality of good insulating material, it is expressed as "*K*", in btu/sq ft/hr/inch thickness/°F differential. Most commercial insulating materials have a *K* value in the range of 0.25 to 0.50.

- **Non-absorbency.** All insulating materials show a decided increase in conductivity when wet. Mere loss of insulating value is a minor consideration in low temperature insulation, however. Many materials do not absorb water. But the point to remember is that the insulating property of a material is in the air spaces between the solids. Once these spaces are filled with moisture, the insulating value is lost, and at temperatures below freezing the system will be wrecked.

- **Structural stability.** Insulating materials must be able to withstand normal construction methods, vibration, thermal stress, abrasion, expansion and contraction of the insulated equipment, and even a certain amount of abuse.

- **Light weight.** Excessive weight in the insulation increases the cost of application, and might even require additional strength in pipe supports or in load-carrying structures.

- **Heat resistance.** Temperatures during cycling process operations or steaming out cycles may rise above the melting point of some insulating materials otherwise perfectly suited to low temperature service. Therefore, even though lower limit of a material is of prime importance in low temperature insulation, the upper limit is important also.

- **Fire resistance.** There are few really "fireproof" materials in use today, although many do not support combustion. This is an important consideration in the petroleum processing plant.

- **Resistance to chemical attack.** Many materials are attacked by solvents or common chemicals. In the petrochemical plant, especially, this factor must be considered and guarded against.

- **Chemical inertness.** If the insulating material is itself chemically active in contact with metal surfaces, severe corrosion and damage can occur. This is a property of the material itself, which should also be checked for its reactions in the presence of any chemicals that may increase its corrosive activity.

- **Ease of application.** The insulating material must be easily fabricated, applied, and handled by normal construction methods. Also, if special skills are required for application, the cost of the system will jump beyond the "reasonable cost" of the successful design.

- **Resistance to rot and vermin.** Materials in storage and sometimes even in service are often damaged by one or both of these causes.

4 types of insulation

THERE ARE many insulating materials, in countless forms, each with its place in the field of low temperature insulation. Most materials depend on finely divided air spaces to retard the transfer of heat. These small air spaces are formed and separated from each other by the flakes, fibers, or nodules of the insulation solids, or are formed by cells in the material itself.

The four general types of insulating materials are fibrous, granular, cellular, and reflective:

1 **Fibrous** insulation may be of organic or inorganic fibers, matted loosely or densely into blankets, bulk or rigid forms. Some common materials for low temperatures are hair felt and the mineral wools.

The insulating qualities of these materials depend on small air spaces between the fibers themselves. Although some of the solids do not absorb moisture, there is virtually no resistance to the passage of water vapor through the air spaces. Therefore, vapor resistance must be furnished entirely by an exterior vapor barrier.

Fibrous materials are economical and easily applied, and may be used successfully in non-critical service in the upper range of low temperatures—above 0°F. Even at these temperatures, the insulation will be only as good as the exterior vapor barrier, however. This barrier must be applied with extreme care and must be protected from any abuse.

Some of these materials are available in either blanket or molded forms with a built-on vapor barrier of a reflective or impregnated paper. Careful sealing of the exterior protection is a must, and abuse must be avoided because the materials are soft and yielding. The vapor barrier will tear and puncture easily.

Although some plants use these materials for insulation of sub-zero equipment, few modern specifications are based on their use, except for temporary systems and non-critical services.

2 **Granular** insulation is made of separate air-filled grains of the material, and can be used in loose or molded form. One common granular material for low temperature is cork—ground, pressed into boards, or pressure-molded into pre-shaped forms.

These materials have some natural vapor resistance, but they are largely dependent on the exterior vapor barrier for protection against water vapor. For many years, cork was the accepted standard insulation for low temperature systems. Properly applied, it can give long and satisfactory service.

With reasonable care, cork can be removed during maintenance and re-used without excessive breakage. It is strong, resilient, and easily applied.

3 **Cellular** insulation is made of a material with small individual cells of air sealed from each other to a large extent. These materials may be foamed glass, plastics, or rubber, and are available in block, and in rigid shapes and flexible shapes.

Most cellular materials are impervious to water vapor. Because of this quality, they are probably the most widely used low temperature insulation today. They are easily applied, and the rigid forms have good structural stability.

Even with an inherent resistance better than any exterior vapor barrier that might be applied, joints must be sealed. Accepted practice today requires an external vapor barrier of mastics and membranes.

Some of the plastic and rubber insulations in this group are severely attacked by some solvents and chemicals, and this factor should be considered wherever they are used.

4 **Reflective** insulation is made of a series of metal or foil sheets, separated from each other by air spaces. It uses both the reflective qualities of the sheets and the air spaces between them for its insulating value.

This form is not in wide use as yet for low temperature systems, although it is the subject of extensive research and is in limited use down to —70°F.

There is no perfect material that will solve all insulation problems. Each has its advantages and disadvantages, and each job has its own special problems requiring custom-made answers. The designer's job boils down to obtaining the most service at the lowest cost.

Most commercial materials will do an adequate job when thermal conductivity alone is the deciding factor, but this is seldom the case. The choice of material is more likely to be on the basis of physical and mechanical properties rather than thermal conductivity.

The most important consideration is to provide and maintain an adequate vapor barrier, taking into account the accessibility of the equipment, the importance of the service, and the maintenance needs.

Economics is a widely varying factor. Each job has its own problems. Very rarely does economical heat gain or loss enter the picture, however. Here again, the control of moisture is the most important factor. Therefore, economics becomes a matter of how long the system is to last. Money spent on the best material available can be largely wasted unless the designer places equal importance on the vapor barrier.

. . and 3 forms

MECHANICAL properties and physical forms, rather than composition, lead to a more useful, practical grouping of insulating materials. This is a common method of classification in the insulating trade and is used mainly because of differences in methods of attachment, vapor barrier requirements, and installation requirements.

1 **Rigid** insulation, characterized by the cellular materials, is largely vapor resistant and does not depend on exterior vapor barriers except for joint sealing.

2 **Semi-rigid** insulation is partially vapor resistant, but depends on an exterior barrier to exclude moisture. Cork is typical.

3 **Non-rigid** insulation includes blanket types such as the mineral wools. These materials have no vapor resistance and depend entirely on an exterior barrier to prevent moisture entry.

Significant characteristics of

MATERIALS	GENERAL FORMS	STRENGTH	RESISTANCE TO: WATER	VAPOR
	Felted into rolls	Soft, flexible; little compressive resistance after application	Good	Moderate
	Formed into pipe insulation and block	Soft, flexible fibers; will not break down under flexing	Excellent	Moderate
	Felted glass fiber blanket with various types of facings	Soft, flexible; little compressive resistance after application	Good	Moderate
	Felted into blanket roll	Standard density, very spongy; heavy density, very firm	Little resistance	Little resistance
	Formed pipe insulation and blankets	Moderate compressive and tensile strength	Good	Moderate
	Semi-rigid blanket, etc., formed into pipe insulation, block and lagging	Moderate compressive and tensile strength	Fair	Moderate
	Molded pipe insulation, blocks, lagging, and fitting covers	Compressible under light load, but does support heavy loads	Good	Fair
	Rigid, fabricated pipe insulation, lagging, segments and fitting covers	High compressive strength; fair tensile strength	Excellent	Excellent

*K is conductivity factor, Btu/(hr)(sq ft)(°F/in)

NOTE: Source of information: "Insulation for Heat & Cold," by Ray Thomas and W. C. Turner, *Chemical Engineering*, Vol. 60, pp. 221-4, June, 1953.

# of thermal insulation materials

COMPOSITION	DENSITY	MAX °F TEMP	K at 32° F*	ADVANTAGES	DISADVANTAGES
Fine glass fibers lightly bonded	1	600	0.270	Flexible; fibers respond to repeated compressing; good thermal cushioning	Pronounced depression ur der heavy loading
Glass fibers bonded	8	600	0.270	Flexible; light fibers will not break down under moderate impact; fair tensile strength	Application limited under certain conditions
Felted glass fibers fabricated with metal mesh or other facing	6	1000	0.21	Flexible; light fibers will not break down under moderate impact; fair tensile strength	Application limited under certain conditions because of binder
100% cattle hair	8.25 (std) 17.25 (hvy)	250	0.25	Emergency low temperature insulation; can be formed over any size or shape pipe or vessel	Requires careful vapor treatment; depends on vapor barrier for good service in low temperatures
Mineral wool fibers with asbestos binders	15	150	0.305	Easily fitted at atmospheric temperatures	Requires careful vapor treatment; depends on vapor barrier for good service in low temperatures
Mineral wool fibers bonded	14	250	0.300	Easily fitted at atmospheric temperatures	Requires careful vapor treatment; depends on vapor barrier for good service in low temperatures
Granulated vegetable cork bonded with natural cork resin	11	200	0.285	High vibration resistance; fair tensile strength	Should be fire-proofed in critical areas
Inorganic glass containing microscopic, hermetically sealed cells	10	800	0.325	Easily shaped and fitted; does not depend on vapor barrier for vapor resistance; incombustible	Should be protected against abrasion

Vapor barrier is highly important

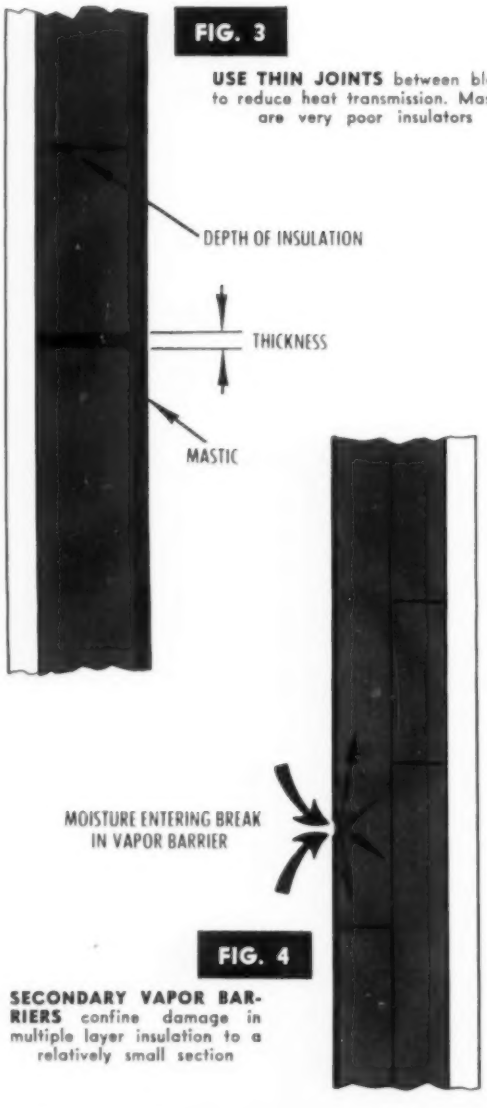
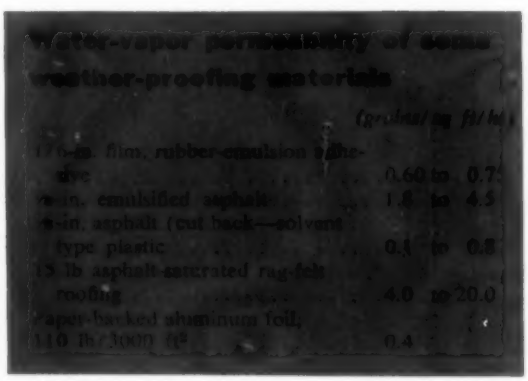


FIG. 3

USE THIN JOINTS between blocks to reduce heat transmission. Mastics are very poor insulators

FIG. 4

SECONDARY VAPOR BARRIERS confine damage in multiple layer insulation to a relatively small section


Water-vapor permeability of some weather-proofing materials

(grains/sq ft/hr)

17-mil. film, rubber-emulsion adhesive	0.60 to 0.7
3-in. emulsified asphalt	1.8 to 4.5
3-in. asphalt (cut back—solvent type plastic	0.4 to 0.8
15-lb asphalt-saturated rag-felt roofing	4.0 to 20.0
Paper-backed aluminum foil, 1.0 lb/3000 ft²	0.4

THE COMPOSITE insulation system will be only as good as the vapor barrier applied to the exterior of the base insulation. In many cases, additional protection —in the form of a weather barrier—is required to protect the insulation from water in the liquid phase.

The vapor barrier may be any type of material that will retard the flow of water vapor into the system. Metals, foils, plastics, and various types of coating may be used, although the most practical and most widely used vapor barriers are a combination of mastics and membranes. These vapor barriers may or may not be an effective weather barrier.

Practically all materials used as vapor barriers allow some vapor transmission, as illustrated by the examples given in the accompanying table. The choice of material should be based on providing an installation that retards moisture sufficiently to obtain the maximum life justified by the economics of the individual case. Not only must the vapor barrier be vapor resistant, but it must remain so for a reasonable length of time.

The temperatures on the outside of the properly designed low temperature system will be near ambient, so selection of mastics for the vapor barrier should be uncomplicated by temperature extremes. Commonly used are the cut-back asphalts, vinyl mastics, latex-based coatings, or epoxy coatings.

Sealing mastics for joints and all possible vapor paths through the insulation must be considered an essential part of the vapor barrier. Here, the material must be tailored to the specific temperature expected at the point of use. Also, temperature cycling problems must be faced, and the mastics must withstand both the high and low temperatures involved. These may run from —100 to 250°F.

Below —100°F, most users have yet to find a material perfectly suited to this application. Above —100°F, the vinyl mastics are used satisfactorily as joint sealers and void sealers. The asphaltic compounds should not generally be used at temperatures below —50°F, because they can become brittle and unyielding, and lose their sealing ability.

Except for the outer vapor barrier, the most efficient application of the mastics will be to use them at a brush consistency, so as to keep joints between blocks as thin as possible. All mastics are very poor insulating materials. A thin coat of mastic will seal a joint as well as a thick coat, with far less heat transmission (see Fig. 3).

Qualities to look for in choosing mastic materials for the vapor barrier are listed on the opposite page.

The different types of insulating materials will require slightly different treatment in design and use.

Rigid insulating materials are usually abrasive when subjected to vibrations or relative movement between sections. For this reason, where vibration is present or anticipated, there should be an antiabrasive compound for the inner face of the insulation where it is in contact with metal surfaces. The choice of the mastic or compound will be governed by the temperature of the insulated body. Some specifications require a bedding compound regardless of vibration, but benefits are questionable except where friction is present.

Although most cellular materials in this group are

entirely vapor-resistant, joint sealers are needed and should be provided—again, as thinly as possible. The inner layers of multi-layer systems are likely to be at very low temperatures. In these situations, it is better to lay the blocks on dry than to use a mastic unsuited to the temperature. The outer layer in all cases will be at moderate temperatures, and joint sealers should be provided at the butt joints.

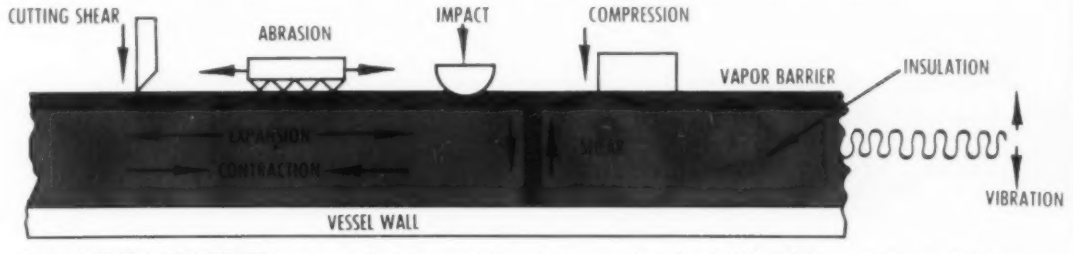
Semi-rigid insulating materials are, for the most part, only partially vapor resistant. The vapor barriers for these materials are somewhat more critical than for the rigid materials. However, these materials generally will not require an anti-abrasive on the inner face of the insulation.

These materials will also require joint sealers at all butt joints. Besides sealing the joints, this treatment of each block will help confine any moisture migration through a broken outer vapor barrier to a single small section of the system. (See Fig. 4.) Multiple layer installations should receive secondary vapor barriers between individual layers. These also restrict the effects of a loss of the exterior vapor seal.

Non-rigid insulating materials of the blanket type are, without exception, non-vapor resistant. Secondary vapor barriers are a must. For maximum vapor resistance, each layer should receive a mastic coating. Where there are many layers of the blanket, this is not always practical. But in all installations, the next-to-outer layer should have a secondary vapor barrier in addition to the outer vapor seal.

Weather barriers: Local conditions may require additional protection for the vapor barrier. Where insulation is subjected to spray or drip from local conditions on the unit, it will be necessary to add a weather barrier over the vapor barrier. This avoids the continually-wet problem and its complications. Metallic or other water-repellent materials should be applied to shed water and keep the vapor barrier free of water in the liquid state. Most commonly used weather barriers are roofing felt and aluminum sheathing. Additional protection may also be required to protect the vapor barrier from damage by hail, or from the abrasions of wind-blown sand.

Piping near walkways or near ground level is often walked on, used to support scaffolding, or just generally abused. In all cases, the vapor barrier is likely to be torn or broken and protection from these abuses should be provided wherever possible.



MECHANICAL STRENGTH in a vapor barrier can help resist these external and internal forces. It is one of the . . .

7 Qualities of a good mastic material for vapor barriers

1 Low permeability. This value, reluctance to vapor transmission, is expressed in "perms," the ratio of the water vapor transmission rate (in grains/sq ft/hr) to the difference in vapor pressure across the barrier (in inches Hg).

2 Adhesive stability. The vapor barrier must bond itself to the insulating material and *hold* its adhesive qualities after drying out.

3 Temperature resistance. Both the high and low extremes that are expected in service must be considered. At low temperatures, some materials will harden or crack; freezing is obviously objectionable. In services where the insulated equipment is subject to temperature cycles, or to steaming out, the mastic must withstand high temperatures also.

4 Mechanical strength. The vapor barrier must have reasonable resistance to cracking and puncturing by outside forces and from internal stresses (see sketch). Because most mastics used as vapor barriers have little or no tensile strength, they are practically always used along with a reinforcing material, such as a high tensile strength glass fabric.

5 Fire resistance. The material should not add to the fire hazard in the plant. Many mastics are fire resistant when dry; but when wet, the solvents are flammable and proper care must be taken.

6 Resistance to chemical attack. Many chemicals found in the plant in the environment where the material is to be used will attack the vapor barrier.

7 Compatibility with base insulation. Solvents in many mastics will attack and destroy certain insulating materials.

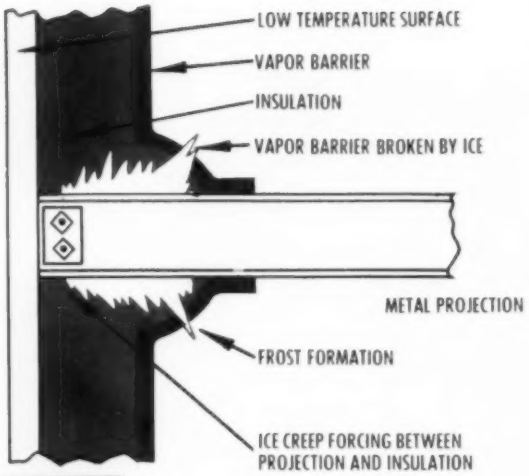


FIG. 5

TO PREVENT ICE CREEP along a metal projection through insulation . . .

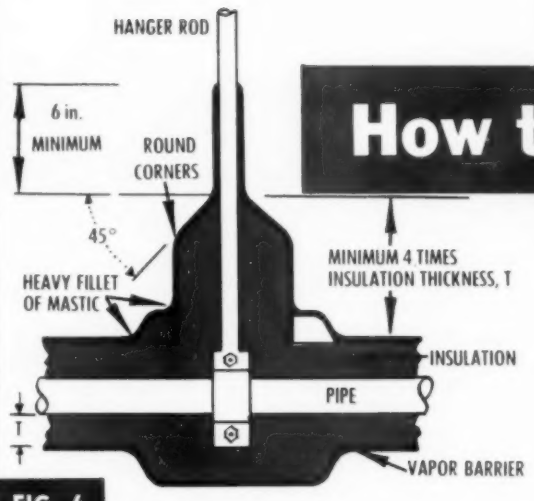


FIG. 6

. . . **DO THIS:** Insulate along the projection beyond the frost zone, as with this pipe hanger

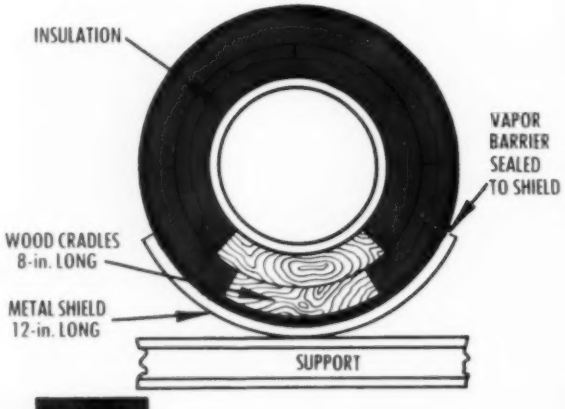


FIG. 7

WOOD CRADLES carry weight of pipe. Vapor barrier must be sealed to metal shield

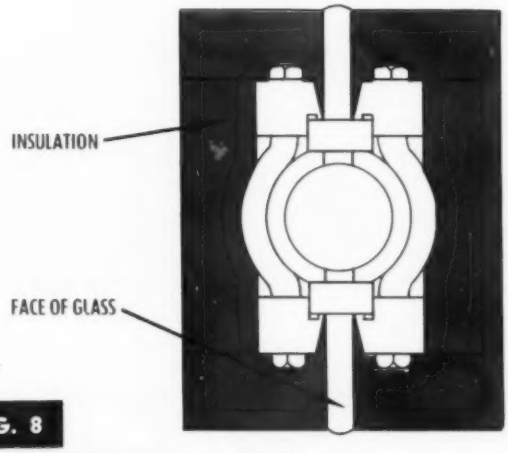


FIG. 8

NON-FROSTING GAGE GLASS has insulation covering entire gage except face of glass

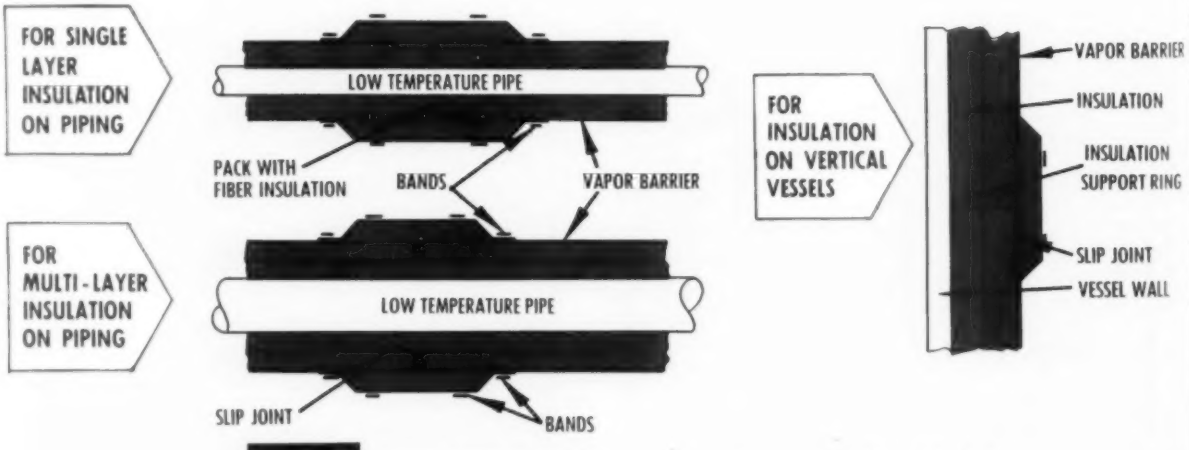


FIG. 9 **CONTRACTION JOINTS** are necessary to prevent crushing of insulation

solve special problems

MOISTURE and its accompanying troubles present many special problems in the field of low temperature insulation.

Projections such as pipe supports and hangers are puzzlers that are totally foreign to high temperature insulation. There is no effective way to seal against moisture migration where a pipe hanger projects through the insulation. This path for moisture can wreck an otherwise adequate system; moisture on the rod will frost, then freeze—bursting the vapor barrier. Progressive disintegration will then continue until the insulation is completely destroyed.

The same problem is faced wherever there is a metal projection from the insulated pipe or vessel through the insulation (See Fig. 5). Typical projections are knee braces for platforms on the sides of towers, thermowells, tower skirts, legs of small vessels, exchanger supports. The thermal conductivity of steel is roughly 900 times that of a good insulant—not particularly important from a heat loss point of view, but troublesome to vapor barriers.

Most common solution is to insulate the projection, and a good rule is to insulate it for a distance equal to four times the thickness of the insulation (see Fig. 6). Careful sealing of the vapor barrier to the metal will provide a reasonably vapor-tight joint and minimize the migration of moisture. The sealing mastic must be suited to the temperature of the projection.

A frequent failure of the vapor barrier at metal projections occurs at a valve packing gland. Gland bolts must be left open for servicing, yet the vapor barrier must be sealed to the valve. When the temperature of the valve is below the minimum temperature of the vapor barrier mastic, a different mastic suited to the temperature must be used.

Rack-supported piping, where the pipe rests on the supporting member of a pipe support, presents still another problem. On high temperature lines, steel saddles or guides project through the insulation to bear the weight of the pipe. In low temperature systems, this would be a projection that could not be insulated as suggested.

One solution, where the load is not great, is to support the pipe outside of the insulation with metal bearing cradles. This is often the solution with the rigid or semi-rigid insulating materials, although in some cases the load may be great enough to require closer spacing of pipe supports to avoid crushing the insulation.

On heavier loads, or with the non-rigid insulating materials, support outside the insulation will not do because the weight of the line will crush the insulation in spite of the bearing cradles.

In some cases, designers have used treated wood saddles to bear the weight of the pipe (see Fig. 7). This is probably the best solution for the particular case, yet it is doubtful that the vapor barrier can be sealed effectively to the saddle. Secondary seals on either side of the saddle will isolate this vulnerable spot and provide protection for the rest of the system.

Gage glasses become a problem in low temperature insulation. They must be insulated or they will frost over so that they cannot be read, yet the glass must be left open. Special frost-proof gages are available for this service with glasses that project outside the frost zone. Insulation on these glasses must all but encase the instrument, and only the face of the glass must show. (See Fig. 8.)

Contraction in lines and vessels must be provided for, otherwise the relative movement of the insulated body will stress and eventually break the vapor barrier. Therefore, contraction joints must be provided to allow for the differences in thermal contractions or expansions between the pipe (or vessel) and the insulation itself. Depending on the temperatures, calculations will usually justify contraction joints at 20 to 30-ft intervals on piping and vessels. Typical contraction joints are shown in Fig 9.

Tower skirts must be considered a metal projection from the tower and insulated accordingly, both on the inner and outer diameter.

Fittings and valves are irregular shaped points that offer another challenge to effective insulation and sealing. Where possible, preformed fitting covers should be used. Otherwise, built-up sectional covering may be tightly fitted. Voids may be filled with loose insulation if recommended by the insulation manufacturer. But, the greater number of joints in a built-up fitting cover make it the most vulnerable part of the whole job and extreme care should be taken to seal the fitting cover from adjacent pipe covering with secondary vapor seals. Some specifications require that fitting insulation precede the adjacent pipe insulation, but a reverse order will allow better isolation of fitting insulation from pipe insulation.

This procedure will restrict any failure of the vapor barrier to the fitting cover itself and will also allow its removal for maintenance without disturbing the pipe covering.

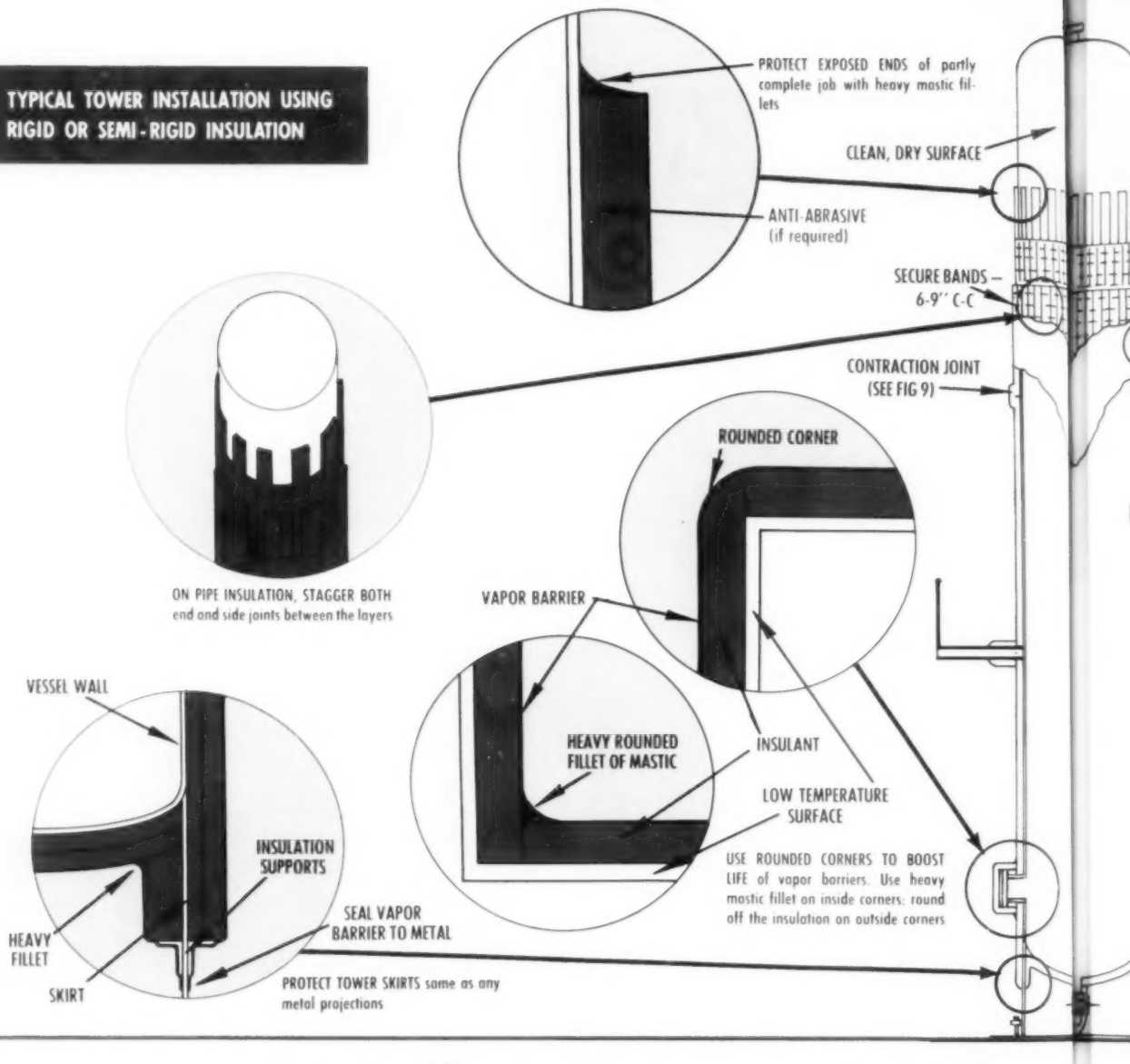
Pumps and other irregular shaped equipment are problems that defy a spelled-out answer. Insulation of this type equipment cannot be generalized and only the basic rules of vapor sealing can be cited. Most applications are similar to built-up fitting covers, tightly fitted and carefully sealed. Voids may be filled with a suitable material but its aid is doubtful. Other jobs on pumps simply encase the equipment in block insulation.

One new development in the field is a plastic-based coating that is troweled or brushed on irregular surfaces. As the material dries, it foams up to 20 times its wet thickness with a structure similar to cellular plastic. And thickness may be obtained by additional applications. Vapor barriers are then applied as to any other insulation.

These are a few of the many special problems that will come up on every low temperature job. The solutions are typical of the methods that have been used successfully. Most importantly, there is no definite "best" way to solve every problem. There is a general "right" way—keep moisture out of the insulation system.

In the low temperature insulation job, careful attention to these details, plus definite specifications on materials, accessories, vapor barriers, and methods of insulation—always with the exclusion of moisture in mind—will give the best possible system at the least possible cost over the life of the installation.

TYPICAL TOWER INSTALLATION USING RIGID OR SEMI-RIGID INSULATION


PROTECT EXPOSED ENDS of partly complete job with heavy mastic fillets
CLEAN, DRY SURFACE
ANTI-ABRASIVE (if required)
SECURE BANDS – 6-9" C-C
CONTRACTION JOINT (SEE FIG 9)
ON PIPE INSULATION, STAGGER BOTH end and side joints between the layers
ROUNDED CORNER
VAPOR BARRIER
HEAVY ROUNDED FILLET OF MASTIC
INSULANT
LOW TEMPERATURE SURFACE
USE ROUNDED CORNERS TO BOOST LIFE of vapor barriers. Use heavy mastic fillet on inside corners; round off the insulation on outside corners
VESSEL WALL
INSULATION SUPPORTS
SEAL VAPOR BARRIER TO METAL
HEAVY FILLET
SKIRT
PROTECT TOWER SKIRTS same as any metal projections

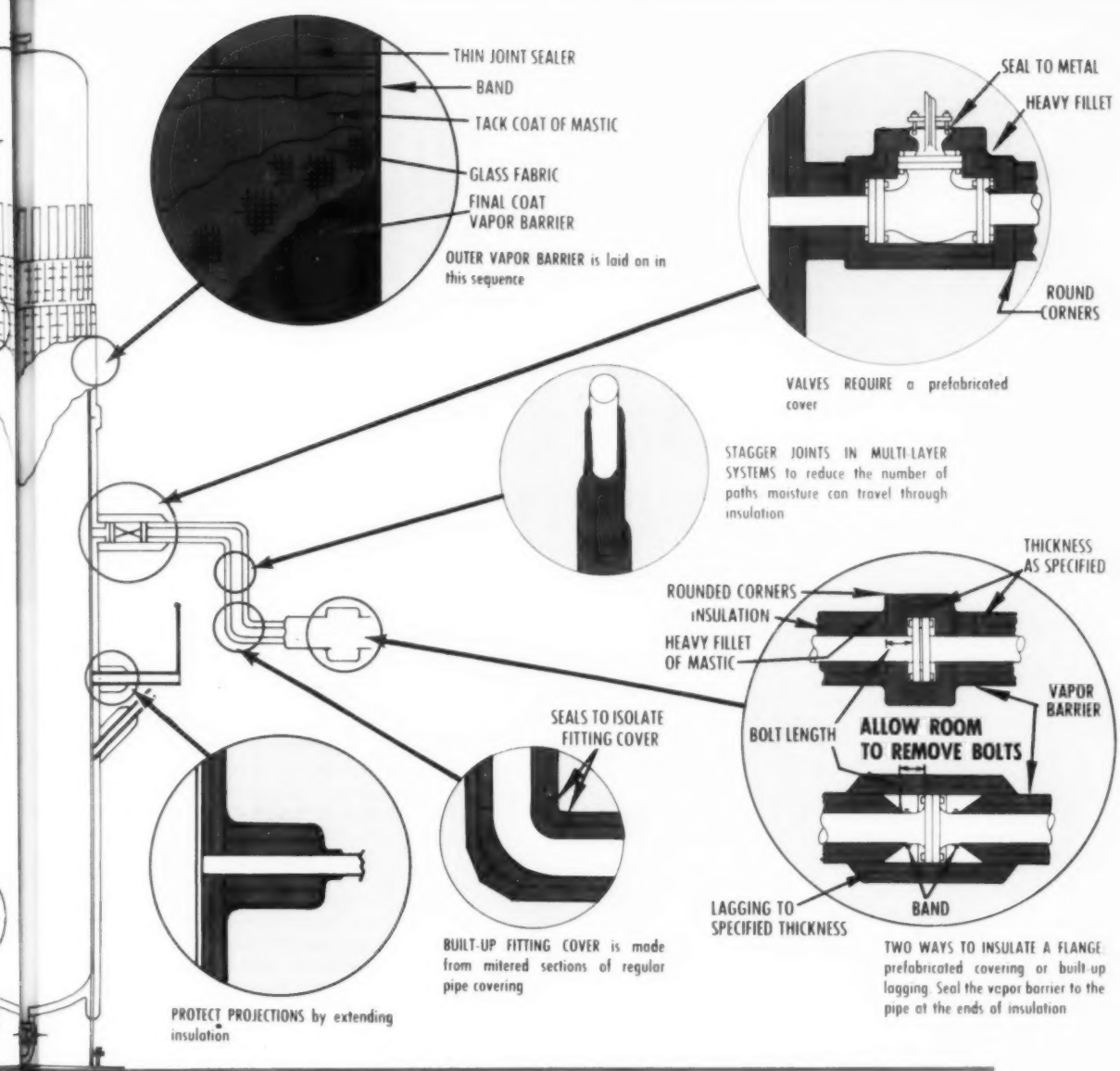
Installing the complete low t

PROBABLY the most critical phase of the insulation job is that of application. It's possible to get a satisfactory low temperature system with inferior materials which are carefully applied. On the other hand, the best materials improperly applied will result in an almost worthless installation. In this respect, the job of the field supervisor supplements that of the designer.

An important point in applying the low temperature insulation is to *protect the system from moisture* by all practical means. This will call for some apparently extreme precautions. Yet the completed job will reflect and justify almost any practical measures that attain this end. There is no effective way to remove moisture once it is absorbed in low temperature insulation.

Here are a few general ground rules for the field job, some of which are illustrated in the drawings above:

- **Protect materials during storage.** This is the first problem the field supervisor faces on the insulation job. Insulating materials must be protected against the elements at all times, from delivery to finished weather coating. Temporary warehouse facilities common to all construction jobs give adequate protection, provided materials are off the ground and are not subjected to damage by inadequate drainage. Decking and covering tarps are not sufficient protection from the elements for any length of time and should not be allowed except in extreme emergencies, and then only for short periods.
- **Plan and schedule field installations.** Proper planning will provide that insulation removed from the warehouse will be applied the same day and that no unprotected insulation will be allowed to remain on the job-site overnight.
- **Protect partially complete jobs.** Pipe insulation


THIN JOINT SEALER
BAND
TACK COAT OF MASTIC
GLASS FABRIC
FINAL COAT VAPOR BARRIER
OUTER VAPOR BARRIER is laid on in this sequence
SEAL TO METAL
HEAVY FILLET
ROUND CORNERS
VALVES REQUIRE a prefabricated cover
STAGGER JOINTS IN MULTI-LAYER SYSTEMS to reduce the number of paths moisture can travel through insulation
THICKNESS AS SPECIFIED
ROUNDED CORNERS
INSULATION
HEAVY FILLET OF MASTIC
VAPOR BARRIER
BOLT LENGTH
ALLOW ROOM TO REMOVE BOLTS
LAGGING TO SPECIFIED THICKNESS
BAND
TWO WAYS TO INSULATE A FLANGE: prefabricated covering or built-up lagging. Seal the vapor barrier to the pipe at the ends of insulation
SEALS TO ISOLATE FITTING COVER
BUILT-UP FITTING COVER is made from mitered sections of regular pipe covering
PROTECT PROJECTIONS by extending insulation

temperature insulation system

should be applied only to the portion of piping that can be completed—including the vapor barrier—the same day. A tower or vessel might require several days or several weeks to insulate. During this time, open joints in the partially complete system will allow rain or other moisture to enter the insulation and work its way to the surface of the vessel.

Every precaution should be taken to see that each day's work is weather-proofed before being left for the night. Where impractical, as in the case of very large towers, a heavy fillet of waterproof mastic over the exposed ends of insulation will prevent water from running behind the material and becoming trapped. (See sketch of tower.) This will be satisfactory for the cellular materials that are impervious to water. For other porous materials, protect the system with tarps or some type of water shed.

- **Apply insulation only to absolutely dry surfaces.** Insulation should never be applied to those surfaces where there is any evidence of moisture. The effect of moisture is the same regardless of how it enters. A second layer of insulation should never be applied over a wet or damp first layer. Likewise, the vapor barrier should not be applied over a wet or damp surface.

- **Stagger joints in multiple-layer systems.** This will reduce the possible paths of vapor migration into the insulation (see tower drawing). Multiple layer systems should have both side and end joints staggered. Single layer applications on piping should have end joints staggered.

- **Use rounded corners.** A must for maximum protection and service from the vapor barrier. Sharp outside corners are especially vulnerable to abuse and

breakage (see sketch in left center of illustration p.108).

- **Seal vapor barrier completely.** This includes sealing the membrane and mastic to all metal projections.
- **Allow space to remove flange bolts**. Piping insulation should be stopped short of flanges, sealed, and then the flange insulated. Then, when the flange is opened during maintenance periods, only the fitting cover need be removed. Otherwise, when insulation interferes with removing bolts, the critical ends of the pipe covering are likely to be damaged.
- **Protect the vapor barrier from abuse.** Where insulation is likely to be walked on, or subjected to extraordinary wear and tear—and these spots are more easily seen in the field—protect the system with metal or felt covers.
- **Fit insulation sections closely and butt tightly.** Broken or chipped sections should be trimmed square. This keeps joints and joint sealers very thin.
- **Make banding secure.** Whatever method of attachment is used—bands, wires, or tape—insist on straight, tight installation. Crooked and insecure banding will soon loosen and allow joints to open in the system.
- **Cover all pump, tower, and vessel openings** when insulating work is in progress. Dust, particularly from the abrasive materials, will collect in equipment and lines and will wreck pump bearings, wear rings, and seals in short order.
- **Stick to the specifications.** Probably more systems have failed because of unwise substitutions than from any other cause. Sometimes, through carelessness, the wrong mastics will be used—the barrels all look alike.

Methods of attachment

Rigid and semi-rigid insulation is wired or banded on 6- to 9-in. centers. Wires or bands can be copper-clad steel, monel, or stainless steel, depending on the severity of the service and the corrosiveness of the atmosphere. Bands may be $\frac{3}{8}$ to 1 in. wide, depending on whether they are for pipe or vessels. Band thickness will be determined by the service—for small lines, light weight bands can be used; for large vessels, heavier bands will be required for the added weight and to allow for the stresses of vessel expansion and contraction. An important point in application is to see that wires or bands are tight and true and not likely to loosen after long service.

Non-rigid blanket type insulation is secured by taping, twining, or tying with glass tape.

Applying the vapor barrier

The vapor barrier is applied in three steps for all types of insulation, except those supplied with a built-on vapor and weather barrier. First step is to spray, trowel, or brush on a tack coat of the barrier mastic. While this coat is still tacky, the glass fabric reinforcing cloth is stretched taut and embedded into the mastic. This fabric should lap at least three inches at all joints and should be wiped wrinkle free. Then, the final coat of mastic is applied to cover the weave of the reinforcing cloth. Final dry thickness will be about $\frac{1}{8}$ in.

Mastic and fabric should extend at least 6 in. beyond insulation at all metal projections to assure a good seal. Heavy fillets of the vapor-proof mastic should be applied to all corners and crevices where water is likely to collect.

How thick should insulation be?

THE THICKNESS of insulation specified in low temperature systems should be sufficient so that the outside surface of the insulation is *normally* above the dew point of the surrounding air. Economical heat gain (or loss), while critical in some cases, is usually incidental to the thickness of insulation in this field. Insufficient thickness is little better than nothing, because a continually wet outside surface reduces the effectiveness of vapor barriers and invites the passage of moisture into the insulation, with subsequent destruction of the system.

One serviceable formula tailored to this dew point requirement is the following (J. F. Stone: "Insulation for Low Temperatures," *Refrigerating Engineering*, Vol 46, No. 1, July, 1943, pp. 31-38):

$$x = R_s k \left[\frac{(t_1 - t_2)}{(t_1 - t_s)} \right] - 1$$

where:

- x = thickness required to prevent condensation, in.
- t_1 = ambient temperature, °F.
- t_2 = temperature of insulated space, °F.
- t_s = temperature of exterior surface of insulation.
- R_s = surface thermal resistance.
- k = conductivity, btu/sq ft/hr/°F/in.

While a strictly accurate calculation would determine R_s for each individual case from published experimental data, a value of 0.65 is recommended to give a quick, usable approximation of the insulation thickness required for most outdoor installations.

Fig. 10 is plotted from the above equation based on a k value of 0.30. Assuming an ambient temperature of 90° F, the curves are shown for two values of $t_1—t_2$ at various surface temperatures. The thicknesses corresponding to these values do not allow for joint losses or other imperfections in the system, and it is not intended for design purposes.

What Fig. 10 does show, however, is that it is not possible to prevent condensation with insulation alone at extremely high humidities, nor is it worthwhile to insulate against the worst conditions to be expected. Obviously there will be conditions where high humidities would require ridiculously thick insulation to prevent condensation. Therefore, the designer must choose design conditions that will result in sufficient thickness to keep periods of condensation infrequent and of short duration.

Insulation thickness calculated by this formula will be for flat surfaces and must be corrected for curved or cylindrical surfaces to compensate for the differences in inner and outer surfaces of the insulation:

Equivalent thickness for curved surfaces $= r_2 \log_e r_2/r_1$ where r_1 = inside radius, and r_2 = outside radius. Fig. 11 is a commonly used chart for converting flat thickness to equivalent curved thickness. The effect of curvature is small when the inside radius is greater than 60 in.

The next question after calculating insulation thickness is: single layer or multiple layer? Stock thickness available will usually simplify this problem, although most materials are made in various thicknesses up to about 5 in. In general, however, thicknesses over 3 in. should be multiple layer, because of increased vapor resistance.

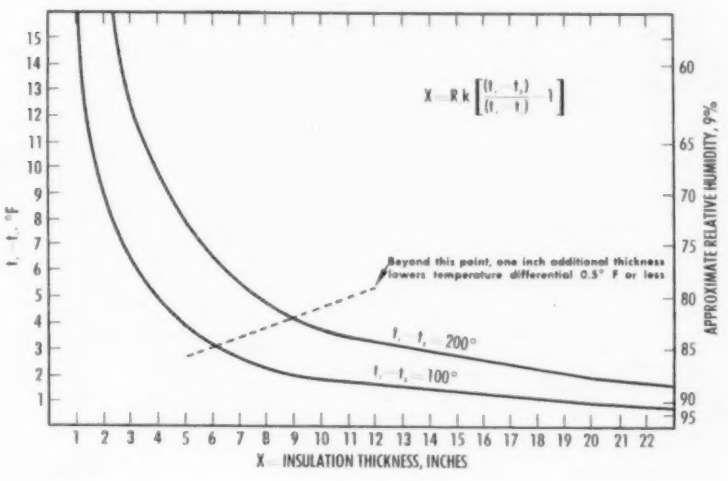

X = R k [(t1 − t2)/(t1 − t) − 1]
t1 − t2, °F
APPROXIMATE RELATIVE HUMIDITY, %
Beyond this point, one inch additional thickness lowers temperature differential 0.5° F or less
t1 − t2 = 200°
t1 − t2 = 100°
X = INSULATION THICKNESS, INCHES

FIG. 10

TYPICAL RELATIONSHIP of thickness to temperature differential and relative humidity, showing practical limits on thickness ranges from 6 to 9 inches

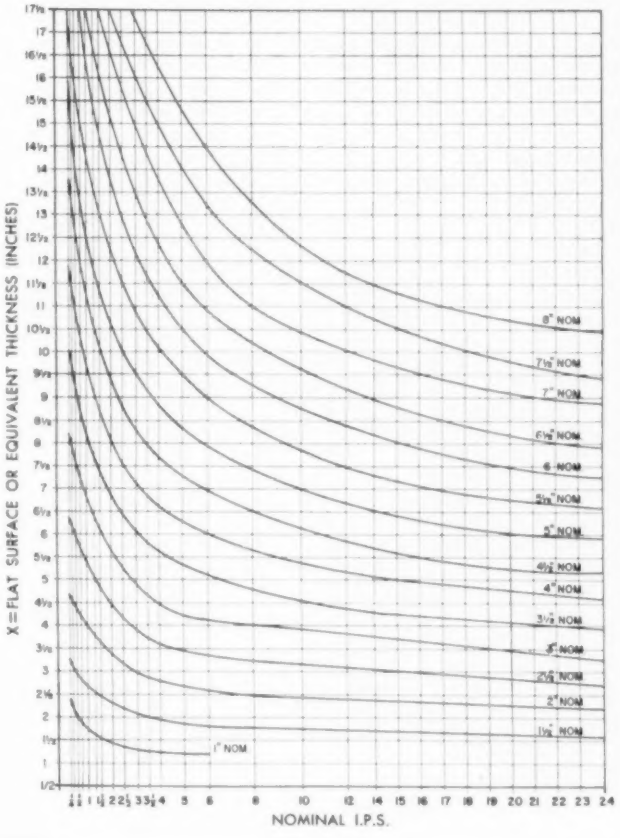


FIG. 11

CONVERSION CHART for determining thickness required on curved surfaces of given pipe sizes from thickness for flat surfaces

Proper maintenance can add life to the system

NO INSULATION SYSTEM, no matter how well designed nor how carefully applied, can be expected to give long and economical service unless it is kept in good condition. Maintenance of the low temperature insulation should have as its primary goal the continued exclusion of moisture by all practical means.

Check vapor barrier

The best and most logical starting point for the maintenance program is with the vapor barrier. Generally, the vapor barrier should be watched closely for signs of checking or cracking, especially after it has been in service for a while. Any visible changes should be checked closely for breaks and repaired promptly.

Check metal projections

Frosting and freezing is almost certain to occur at many metal projections, and at practically all bleeder valves and vent valves in the piping system. Assuming the insulation at these locations is properly isolated from the main piping insulation, there is little to worry about, but they should be watched closely. If any heaving or buckling of the insulation occurs, it should be removed and replaced during the next turnaround.

Look for vibration

Other troublesome spots in the system will be at contraction joints, around manway openings, at pumps, fittings, or where there is excessive vibration. The vapor barrier should be inspected at these points at frequent intervals, with particular attention to corners, edges, and joints. Any cracks or openings in the vapor barrier should be pointed up immediately and an inspection of the underlying insulation made at the next turnaround.

Avoid physical abuse

Throughout the life of the insulation, the vapor barrier should be checked for physical abuse from falling objects, other maintenance work, and general wear and tear. The insulation system, and especially the vapor barrier, is usually damaged severely during turnarounds, and repairs should be made as fast as the unit is closed up before going back on-stream.

Replace damaged insulation

Unfortunately, the base insulation is not so easy to inspect while the unit is in operation. Failures usually make themselves known by icing, heaving, or buckling from ice underneath the system. These sections must be removed at the first turnaround and replaced with dry insulation. Maintenance crews must be careful to remove all of the affected portion and re-seal the system completely.

Check for corrosion

While insulation is removed from piping or vessels, it is wise to check the metal surfaces for corrosion caused by moisture under the insulation. Any mild corrosion should be cleaned thoroughly and painted with a rust-inhibiting coating.

Inspect attachments

While the unit is down is a good opportunity to observe the insulation system for future trouble. Any water dripping from the insulation after the system warms up should be traced for a break in the vapor seal. The extent of wet insulation should be determined and corrected.

Additional expansion joints are needed if the insulation tends to separate. These can be installed during turnarounds.

Other routine inspections should note any corroded or loose bands or tie wires. These should be replaced without breaking the vapor barrier while the lines are cold. If necessary, place temporary banding over the vapor barrier, then do a finish job at the next shutdown.

Use skilled craftsmen

In all cases, removal of insulation for maintenance work should be done by skilled insulators. While insulation is removed from the system, extreme care should be taken to protect the insulation from water and the weather.

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WOLVERINE TRUFIN® BOOSTS ASPHALT HEATER EFFICIENCY

Finned Tube Exchangers on Stream Three Years

BY ERNEST DODD

Until recently in processing work, such heat transfer applications as heating asphalt, crude oil and other heavy residuum materials have been regarded as "tough, dirty jobs."

However, a new day has dawned. Now, thanks to Wolverine Trufin—the integral finned condenser tube—you can heat viscous materials as easily and with as good results as many clean service materials.

As proof of this, consider the performance of two shell and tube U-bend heat exchangers which are used by a Pennsylvania company to heat asphalt, as it moves through transportation lines from the processing plant to storage or distribution.

The exchangers operate with steam on the tube side and asphalt on the shell side. Each is tubed with 112 lengths of Trufin Type S/T, electric-welded steel tube in prefabricated U-bend form. Each has a total surface area of 1600 square feet.

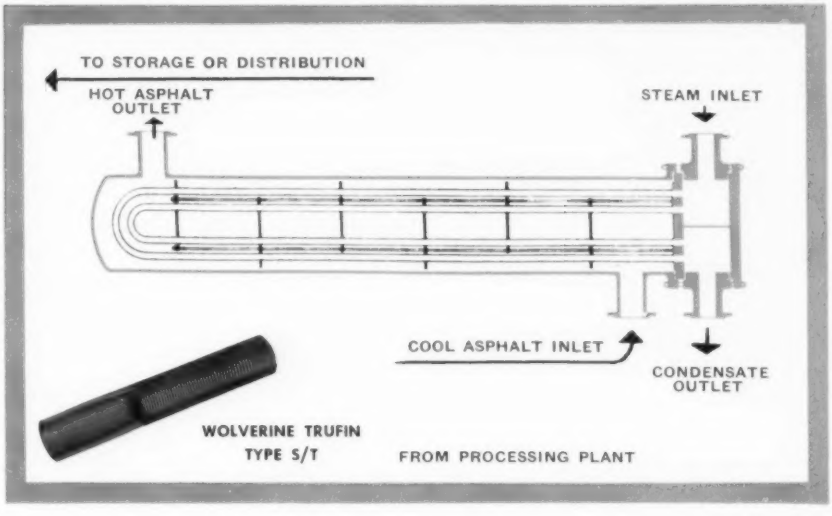
These two units have been continuously on stream for three years and are still going strong. During this time they have not required cleaning or retubing.

Performance such as this, however, is no longer regarded as unusual—when heat exchangers or condensers are tubed with Wolverine Trufin Type S/T condenser tubes.

Through actual on-the-job use, plus extensive pilot plant research and exhaustive laboratory testing, engineers are proving that integral finned Wolverine Trufin resists fouling for longer periods than does prime surface tube.

In addition to increasing on stream time, Trufin also boosts heat transfer capacity because its extended surface extracts more BTU's per foot of tube. As a result, units tubed with Trufin require fewer tubes and smaller shells to obtain equivalent heat duty. The savings in material, labor and construction time are substantial.

For example, the asphalt heaters described in this article, require 116 lengths of Trufin enclosed in 17¼" I.D. shells to obtain individual heat transfer surface areas of 1600 square feet. If designed around prime surface tube, each unit would have required approximately 234 tubes and shells 25" in diameter.



WOLVERINE ONLY DIRECT MILL SOURCE FOR U-BEND CONDENSER TUBES

Through the use of prefabricated Wolverine U-bends in the asphalt heaters described on this page, the engineers concerned realized substantial savings in time, materials and labor.

As the industry's only direct mill source, Wolverine prefabricates U-bends to customer specifications. The tubes are then shipped in expendable type pallets in the exact order of their installation—ready for direct insertion into the unit.

One tube sheet is eliminated and floating head problems are reduced. Rolling in operations are cut in half. Wolverine U-bend tubes also eliminate the shipping and handling problems present when requirements call for condenser tubes over 30' long.

Wolverine prime surface U-bend tubes are available in a wide range of sizes and alloys in copper and aluminum. Capacity-boosting Trufin U-bends are available in copper, copper-base alloys, aluminum, electric-welded and seamless steel.

SEND FOR FREE BOOK

Because of the nature of its contents Wolverine's Condenser Tube Catalog can serve as a worthwhile addition to engineering reference files. Besides descriptions of Wolverine's complete condenser tube line this catalog contains valuable information on alloys, corrosion, finned tube and its applications and many other subjects of direct interest to those engaged in heat transfer work. Send for your FREE copy today.

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To meet the heat transfer needs of the refining and processing industries, Wolverine Tube manufactures condenser tubing in both integrally finned and prime surface form. Each type is the product of Wolverine Tubemanship—is backed by Wolverine's years of tubing experience, constant research, sound engineering and rigid quality control.

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Wolverine Trufin® Type S/T was designed specifically for shell and tube installations. This integrally finned condenser tube steps up heat transfer performance because its extended surface extracts more BTU'S per foot of tube.

Type S/T is available in the following alloys:

- Copper
- 70-30 Cupro-Nickel
- 90-10 Cupro-Nickel
- 85-15 Red Brass
- Admiralty
- Electric-welded Steel
- Seamless Steel
- Aluminum Brass

SIZE RANGE:

Specified O.D.

1/2" • 5/8" • 3/4" • 7/8" • 1"

PRIME SURFACE TUBE

For those heat transfer applications where integrally finned tube is not applicable, Wolverine recommends its prime surface condenser tube. This tubing is rigidly quality controlled to insure maximum performance under the toughest of operating conditions.

Wolverine Prime Surface tube is available in the following alloys:

- Inhibited Admiralty
- Copper
- Cupro-Nickel 10, 20, 30%
- Aluminum Brass
- Red Brass
- Muntz Metal
- Aluminum

SIZE RANGE:

Outside Diameter	Wall Thickness
5/8" O.D. to 2" O.D. Inclusive	.049 to .083
	.049 to .134

FIELD ENGINEERING SERVICE

For the convenience of its customers Wolverine maintains its Field Engineering Service—a staff of highly trained tubing technicians. These heat transfer and tubing specialists are trained to come up with the right solutions to problems in design, corrosion alloys, etc. Their services are yours without obligation—can help assure you of complete tubing satisfaction.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

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Your Guide to . . . Petroleum Processing Departments

Keep Your Data File Up-to-Date

"Clip-n-File" process data
Powerforming for octanes

Here's a three-page foldout flowsheet that describes Esso Research's new Powerforming process. Diagram and text make a handy reference unit.
turn to **p. 119**

"Clip-n-File" engineering data
Instrument glossary

Final section of PETROLEUM PROCESSING's new glossary of instrumentation terms, made to keep up with advances in instrument technology.
p. 131

No waiting for tools

This mobile tool shop serves 350 men during turnarounds. A charge-a-plate system, combined with efficient racks helps keep Union Oil's turnarounds running smoothly. See Plant Practices, **p. 123**

Why the Old Man turned Thespian

The green engineer was a classic eager beaver and had to be taught the facts of refinery life. The Old Man went dramatic to make the lesson as painless as possible. Bull Pen starts on **p. 127**

Are you missing opportunities?

Every month, PETROLEUM PROCESSING's back-of-the-book columns offer valuable literature from manufacturers. You can procure these items by using the Reader's Service Card.

A chain is only as strong . . .

as its weakest link; and a piece of equipment, as its weakest bolt. These bolts are almost as strong at 900°F as most high-strength fasteners are at 90°. See What's New for details, **p. 161**

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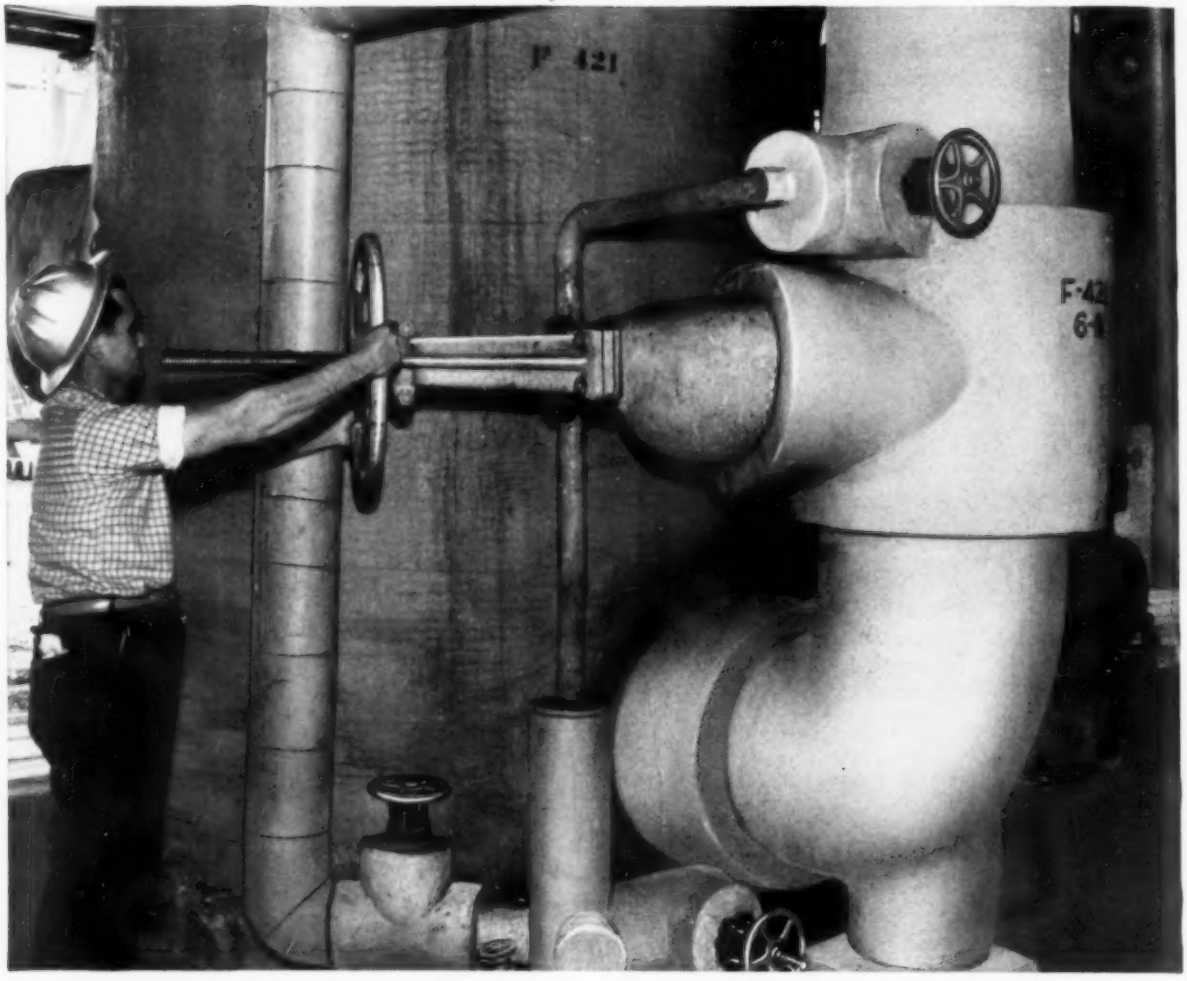
Hard to Beat in Any Service—Crane Valves



Distinguished in Service on hard-to-hold fluid in petrochem processing

Some fluids by nature are appreciably harder to hold than others, even at low pressures and temperatures. One such fluid is cuprous ammonium acetate, being handled as shown here with a Crane 14-in. steel wedge gate valve.

This installation is at Petroleum Chemicals, Inc., a large butadiene plant at Lake Charles, La. Working pressure is less than 50 p. s. i. and the temperature is under 32 F°.

The low line pressure against the disc when closed, doesn't help much to keep the valve tight. Leakproof closure on the fluid depends entirely on the quality of bearing surface finish, the preciseness and accuracy of disc travel, and resistance of seating members to corrosion.

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Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

Process—Fixed-bed, catalytic reforming process using a regenerable platinum catalyst to upgrade the octane number of naphtha feedstocks.

Process flow—A typical Powerforming unit designed to produce a 95 to 100 clear octane product includes four reactors on-oil, one swing reactor, preheat and reheat furnaces, and catalyst regeneration facilities. In addition, a Powerformer includes a feed Hydrofiner, a recycle gas system, and a product stabilizer. Where a better feed stock is available, or the required octane number of the product is lower, the swing reactor can be eliminated. In this case, the catalyst is regenerated at intervals of 2 or 3 months.

The primary reactions involved in the process are dehydrogenation of naphthenes to aromatics and the dehydrocyclization of paraffins, with some isomerization and hydrocracking occurring. The net result is more or less endothermic with the degree depending upon the composition of the feed and on the severity of reforming.

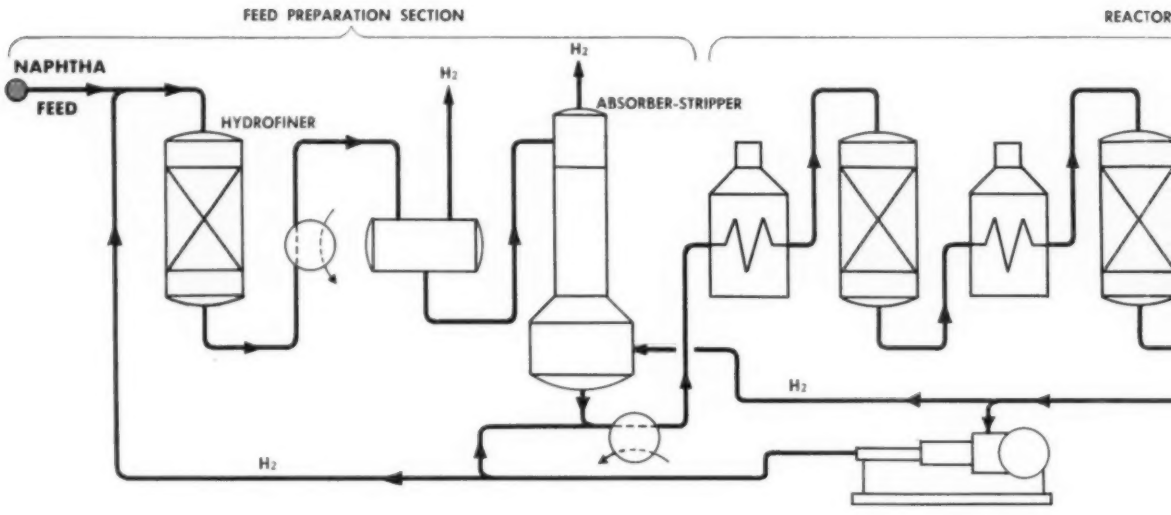
Referring to the flow diagram, naphtha feed is desulfurized in the Hydrofiner using hydrogen from the reforming reactions. Desulfurized naphtha is combined with compressed recycle gas from the separator drum following the last reactor, and charged to the first reactor via the preheat furnace. The reheat furnaces between the reactors furnish heat to maintain the desired temperatures in the downstream reactors.

If no swing reactor is used, the entire unit is taken off-stream for catalyst regeneration every two or three months. When a swing reactor is used, catalyst activity is maintained by regenerating each reactor as necessary without taking the unit off-stream. A Powerformer is designed so that the swing reactor can take the place of whatever reactor is being regenerated. This feature assures essentially constant product octane number with virtually no changes in operating conditions. The hydrogen content of the gas produced re-

Product yields and quality at 100 Research Octane for Powerforming

Feed Source	Arabian	Arabian[1]	Arabian[1]	Redwater	Mixed La.	West Texas
Nominal cut range, °F	160/260	160/300	300/385	170/310	200/330	200/300
Feed properties						
Gravity, °API	64.7	61.6	49.6	57.2	55.0	53.0
Research octane, clear	44	42	26	58	58	56
ASTM 5% point, °F	199	190	310	220	223	235
ASTM 50% point, °F	217	236	342	241	253	260
ASTM 95% point, °F	249	294	380	288	304	291
Watson K factor	12.2	12.1	11.9	11.9	11.8	11.7
Yields, % on feed						
C_5+, vol%	60.1	64.3	78.3	73.5	77.5	81.0
H_2, wt%	1.6	1.3	1.3	2.4	2.1	2.0
C_1, wt%	2.9	2.3	1.3	2.1	1.7	1.5
C_2, wt%	7.0	5.9	2.8	3.7	2.9	2.5
C_3, wt%	11.1	10.0	5.7	8.2	5.1	4.4
C_4, wt%	17.0	15.0	8.4	10.7	8.8	7.8
C_5 + Powerformate properties						
Volatility, % D + L @						
158°F	27	22	2	9	4	5
212°F	62	50	16	43	29	21
257°F	85	73	29	66	60	59
302°F	94	90	45	89	84	85
356°F	98	97	74	97	96	98
ASTM Final B.P., °F	381	392	444[2]	396	402	385
Gravity, °API	53.0	49.0	40.0	47.5	45.9	44.3
RVP, psi	7.6	7.5	2.7	4.5	4.0	3.5
Octane Numbers						
Research clear	100	100	100	100	100	100
Research +3cc TEL	105.6	105.6	105.6	105.6	105.6	105.6
Motor clear	88.6	88.6	88.6	88.6	88.6	88.6
Motor +3cc TEL	94.8	94.6	93.2	93.6	93.1	93.1

[1] An Arabian 160/385 was split into two fractions for running in blocked operations for these two cases.
[2] Before rerunning.



mains steady, making it an ideal stream for Hydrofining other refinery stocks.

Catalyst—Uses an Esso Research-developed catalyst consisting of platinum on an alumina base. The catalyst has an extremely high activity and a long life. Under the license terms, Powerforming licensees can use new catalysts which may be developed by Esso Research.

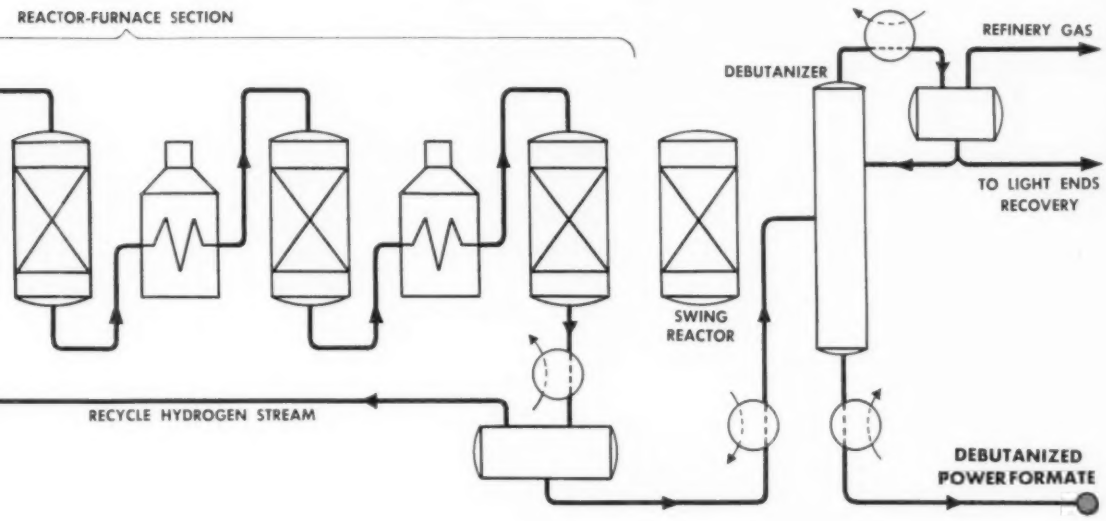
Catalyst regeneration—An improved regeneration technique removes carbon and sulfur compounds, and overcomes more permanent deactivations (probably caused by physical or physicochemical changes). Regeneration essentially restores original catalyst activity and selectivity.

Typical regeneration facilities use 16-24 hours to regenerate the catalyst in a reactor. In a unit with a swing reactor, the entire catalyst charge

Installations for Powerforming Units, operating, building or approved

Company	Location	Capacity, b sd	Res. Oct. Clear	Unit Type	Startup Date
Esso Standard Oil Co.	Baltimore, Md.	3,000	92	Semi-Regen.	7-55
Imperial Oil Ltd.	Edmonton, Alta.	2,200	85	Semi-Regen.	8-55
Carter Oil Co.	Billings, Mont.	2,500	85	Semi-Regen.	2-56
Raffineria Garrone*	Genoa, Italy	5,600	95	Cyclic	1-57
Imperial Oil Ltd.	Sarnia, Ont.	15,000	95	Semi-Regen.	2-57
Imperial Oil Ltd.	Halifax, N. S.	7,000	95	Cyclic	(1957)
Imperial Oil Ltd.	Montreal, Que.	9,000	95	Cyclic	(1957)
Esso Standard Oil Co.	Linden, N. J.	20,000	98	Cyclic	(1957)
STANIC	Bari, Italy	7,300	100	Cyclic	(1957)
RASIOM*	Augusta, Sicily	7,300	100	Cyclic	(1957)
Esso Standard Oil Co.	Everett, Mass.	7,200	98	Semi-Regen.	(1957)
Esso Italiana	Trieste, Italy	1,000	91	Semi-Regen.	(1957)
International Refineries, Inc.*	Wrenshall, Minn.	2,800	95	Semi-Regen.	(1957)
Imperial Oil Ltd.	Ioco, B. C.	5,500	98	Cyclic	(1957)
Esso Standard Oil, S.A.	Belot, Cuba	2,665	85/95	Semi-Regen.	(1957)
Imperial Oil Ltd.	Winnipeg	3,000	98	Cyclic	(1958)
Esso Standard Oil Co.	Baton Rouge, La.	26,900	100+	Cyclic	(1958)
Esso Standard Refinery, S.A.	Antwerp, Belgium	5,600	100	Cyclic	(1958)
Esso Standard Soc. An. Fr.	Port Jerome, France	14,500	100	Cyclic	(1958)
Cie. Francaise de Raffinage*	La Mede, France	20,000	98	Cyclic	(1958)
Esso Petroleum Co., Ltd.	Fawley, England	21,000	100+	Cyclic	(1958)
Standard Vacuum Oil Co.	Durban, So. Africa	5,600	100	Cyclic	(1958)
Esso A.G.	Cologne, Germany	9,000	100	Cyclic	(1959)
Esso Standard Soc. An. Fr.	Bordeaux, France	8,100	100	Cyclic	(1959)

*Licensees



Powerforming for octanes

. . . with Esso Research cat reforming

UNFOLD FOR START OF PROCESS DESCRIPTION

(including swing reactor) could be regenerated every 80-120 hours, if necessary.

Operating conditions—Typical Powerformer operating conditions are 300-450 psig, 900-1000°F reactor inlet temperature, 4000-6000 SCF/bbl recycle gas rate, and 1-4 w/hr/w space velocity.

Feedstocks—Typical feedstocks consist of low octane naphthas in the boiling range from 160-400°F. Even Middle East naphthas containing more than 70% paraffins can be converted to 100 octane (clear) products in a Powerformer.

Product yields—The accompanying product yields and quality table for 100 Research Octane Number clear give details for five different feedstocks.

Utilities—Typical utility requirements for a 10,000 b/sd Powerformer are 2000 lb/hr steam, 2500 kw power (based on electric motors for all pumps and compressors), 3700 gpm cooling water (assumes a 25° rise in cooling water temperature), and a 150 MMBtu/hr direct fuel.

Installations—Five Powerforming units are onstream, with a combined capacity of 28,300 b/sd with at least 20 more scheduled to be onstream in the next two years. The units planned represent a total capacity of just under 200,000 b/sd. All operating, building or approved Powerformers are listed in the accompanying table of installations.

Licensor—Process licenses for Powerforming can be obtained from Esso Research & Engineering Co., 15 West 51st St., New York 19, N. Y.

References—Further information on "Powerforming" can be found in:

(1) Petroleum Processing, "Powerforming is No. 14," Apr. 1956, p. 69.

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SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

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IN 1884...73 YEARS AGO...

They Scoffed at Wm. Graver's Determination to Build Storage Tanks with Light Plate

Quoted from an article "Graver Tanks Are Monuments to Confidence, Energy and Skill," The Southwestern Oil Journal, December 5, 1919:

"• • • It had been the theory of Chicago tank builders that tanks should be constructed like boilers—made of heavy material and capable of standing a great pressure. Mr. Graver could erect his tanks much cheaper than those being put up by the Chicago concerns, but he was unable to get his just share of the business. He took contracts for other kind of work and his perseverance was finally rewarded by a contract to build four linseed tanks of considerable size for a Chicago concern. Failure was predicted by his competitors and Joseph T. Ryerson, from whom he was purchasing the material, also became skeptical of the outcome.

Having called Mr. Graver into conference and being assured that he had successfully constructed the lighter tanks for the Standard Oil Company, Mr. Ryerson gave the oil company his word that the tanks would fill all requirements and Mr. Graver was allowed to go on with the contract. William Graver, his son, J. P. Graver, now president of the company and Mike Sheets, the construction foreman, got the material out for the tank at their plant in Clark street.

The tank trade was especially interested in the construction of the tanks and they gathered daily to watch the erection. Gloomy predictions were voiced from the laying of the bottoms to the completion of the tanks. However, William Graver had his day when the first tank was tested out. A large crowd was on hand to see the tank filled up, and as the gauge on the tank soared and it still held, many of his competitors turned on their heels, wiser apparently in tank construction.

It was upon the completion of this tank that William Graver began to reap the fruit of his labor. Orders came pouring in and from that day to this the Gravers have been favored with a large share of the tank business."

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(To obtain more data on advertised products see page 158)

you can judge

the comparative values of furnace design as applied to operating requirements.

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Tips for tool handling at turnarounds

By E. B. STRICKER*

AT THE Los Angeles refinery of the Union Oil Co., several good techniques have been developed for efficient handling of tools during turnarounds. They have proven successful in checking out tools to both Union Oil and sub-contract maintenance workers during unit overhauls.

One system recently adopted makes use of charge-a-plates in checking out tools. It has proved satisfactory and economical for tool records and for issuing maintenance equipment from the main tool room in the shops area.

In the turnaround area a different system is used to accommodate as many as 350 people of various crafts as they check out tools from a mobile tool room. This mobile tool room is eight feet wide, twenty feet long, and has a counter-type window on the side. It is fully stocked with tools ranging from small screwdrivers to heavy pneumatic impact motors. The small pocket-size tools are issued on the charge-a-plate system, while the heavy tools are issued on a serve-yourself basis. They are painted white to distinguish them from tools issued from the main tool room.

Portable racks hold the large tools in an area around the mobile tool room and are available to all crafts. Racks hold air hoses, chain blocks, com-a-longs, all pneumatic tools, socket wrenches, sledge hammers, wire ropes and other types. One interesting and helpful aid is the mounting of different size nuts on the side of the racks holding socket wrenches, spuds and spud knockers. This permits both the person returning the tool, as well as the one checking it out, to make sure of the correct size.

By using this serve-yourself method for large tools and the charge-a-plate for the small items, the mobile tool room is operated with only one toolkeeper. And no one need wait in line for tools. Union Oil has found that tools are lost very seldom. Returning tools after completion of the job has been accomplished by the cooperation of craftsmen and foreman who use this unusual system.

Turn page for more Plant Practices

*Mr. E. B. Stricker is Master Mechanic at the Los Angeles refinery of the Union Oil Company.

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Insulate with both feet on the ground

INSTEAD of insulating the boiler stack after it was erected, engineers of the American Bitumuls & Asphalt Co.'s Cincinnati, Ohio, refinery specified insulation on the ground—and cut costs on the job to a minimum.

This shop-fabricated stack was set on blocks and insulated with two 1-in. magnesia blocks held in place with stainless bands placed 1 ft apart. The outside surface was then covered with 1-in. #19 galvanized poultry wire, which served as a lath and reinforcement for the applied asphaltic protective material.

After the asphaltic material was troweled on in two thin layers and cured, the stack was lifted at its top by a crane and set in place. The result: a quicker, minimum cost job with no working hazard.

Scrap equipment makes acid trailer

THAT'S what Shamrock Oil and Gas Corp. did at its natural gasoline facilities at the McKee plants, near Sunray, Texas. This trailer was made from old, discarded material. Its purpose: to transport acid around the plant. The tank itself—an old carbon accumulator—is mounted on an old welding machine frame. The frame is supported by transverse auto springs and axles, and uses automobile wheels.

Because Shamrock makes its own sulfuric acid from acid sludge, hydrogen sulfide and elemental sulfur, there was the problem of transporting acid among many locations within the plant. The tank of the trailer is filled with 98% sulfuric acid through an opening in the top. Another top opening serves as a vent to prevent pressure build-up while filling.

Acid is discharged by pressurizing

the tank with air fed through a pressure regulator set at a maximum of 10 psig. The discharge valve is made of stainless steel.

The trailer can be moved by a pick-up truck attached with a trailer hitch. A ladder and platform on one side of the acid tank permits operators to reach the top of the tank for manipulation of the valves or inspection.

Custom designed stool

A SIMPLE step-stool of just the right height and with non-slip steps aids the boiler room operators in Dorchester's Cargray natural gasoline plant near White Deer, Texas.

The frame of the stool is made of ½-in. tubing from an old exchanger bundle. Along the back and front are 1-in. angles for stiffening the tubular frame. The steps were cut to size from metal grating, and welded into place.

The width of the hand-made stool is about 16-in., and the whole assembly is just the right height to reach otherwise inaccessible spots—a custom-made job. The stool is firm enough for safe use.

• • •

OAKITE

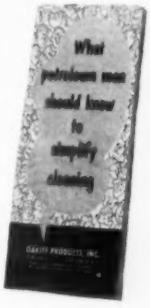
Sets New Speed Records

Cleaning Tough Towers Chemically

During a recent turn-around at a large refinery a problem came up when the maintenance crew, working with Oakite materials and methods, reached the 5-tower alkylation unit. Until then everything had gone so smoothly that the turn-around was practically a spin-around.

Now the problem was: how to get rid of every trace of HF acid in the stripper and de-iso towers. This was necessary because plans called for cutting out by torch all the old trays in these two towers and replacing with new trays.

It seemed too much to expect, even from Oakite. But here's what happened. The Oakite Technical Service Representative recommended using Oakite Compound No. 85. This was circulated for 16 hours and then pressure rinsed. Result? Not a trace of acid in the amazingly clean towers – and in addition, a new record was set for speed in this cleaning operation.



Maybe Oakite can help you, too, to set new records for efficient maintenance cleaning. Call your local Oakite man, or write for free booklet 7629. Oakite Products, Inc., 50D Rector Street, New York 6, N. Y.

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Technical Service Representatives in Principal Cities of U. S. and Canada

(To obtain more data on advertised products see page 158)

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Isolates and protects bellows from turbulence caused by flowing media — reducing possibility of fatigue failure.
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Crosby
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(To obtain more data on advertised products see page 158)

How the Old Man Put Gravity to Work for Him

"My boss fired me. I was out of that plant in 20 minutes."

THE OLD MAN has a personal policy of letting everybody around here run his own business as much as possible. Says he, "Let a man make a mistake once in awhile and he won't make the same one again. I like a man with guts—as long as that's not all he has to offer."

I guess about the cheapest lesson I've seen around here lately was learned by a new engineer over in the water treating plant. We were adding a new filter to a bank of three concrete gravity filters and the new guy was in charge of construction and initial operation. He was working for Cruse, the Utilities Superintendent.

One day during the job, the Old Man called me up to his office from the Bull Pen. "What's this all about?" he asked, and handed me a duplicate of a purchase order cancelling the anthracite coal filtering medium for the new filter. The order was signed by Cruse.

"I dunno. Cruse is on vacation, but maybe I can find out." I wandered over to Cruse's office to talk to his clerk.

"What do you know about this order cancelling coal for the new filter?" I asked.

"Beats me," he said. "The requisition came in from that new guy over in the water treating plant, and Cruse signed it. 'Course, you realize Cruse is pretty absent-minded about signing things—one day a maple leaf blew in on his desk and he signed it."

Well, things began to shape up after a little more talking around, and I thought I had the story pretty well worked out by the time I got back to the Old Man's office.

"Looks like that new guy is figuring on getting that coal out of this refinery. I found another requisition made on the same day for sand and gravel. The guy is pretty sincere, you know, and I'd guess he's been readin' up on how you can use sand and gravel for a filtering bed."

The Old Man grinned big. "Let's go over to the water treating plant. I gotta talk to that boy," he said.

"How's it goin'?" he asked when we got to the job. "When you gonna be ready to put in the filter bed?" The Old Man was playing coy, and I was curious to see what he had up his sleeve.

After a tour of the plant, the Old Man idled around with a little small talk.

"Ya know," he said to me and the new boy, "I guess one of the dumbest stunts I ever pulled was back in the days when we used sand instead of coal for a filtering medium in these things."

The boy perked up. "What happened?" he asked, with the look of a man about to be run over by a truck.

The Old Man laughed. He was sure dragging this one out. "Well, I was running a treating plant in Jersey—had about ten of these filters. Every so often, we had to change the filter bed—put in new sand and gravel. First time I tried it, I just ordered the material and dumped it in—real proud of myself for saving money on that change."

"What was so dumb about that?" I asked, playing the straight man.

"Nothin.' Everything worked fine when we put the filter in operation. Fine, that is, until we backwashed. When we backwashed, the whole filter bed turned upside down—sand went to the bottom, and gravel came to the top. Took three days to clean all that sand out of the underdrains and piping. 'Course I wasn't around to see that—my boss fired me. I was outa that plant in ten minutes, but I heard later that the sand had gummed up the plant for days. I wouldn't have blamed my boss if he'd shot me."

"Wh-what caused the bed to upset?" the boy wanted to know. He looked ready for the noose.

"Ever hear of specific gravity? That's what did it. Sand and gravel make a fine filter bed if your coarse and fine materials have the same specific gravity. Otherwise, when you backwash, the heavy material goes to the bottom, and the lighter material comes to the top. I didn't have sense enough to check that when I bought the replacement material. Dumbest stunt I ever pulled."

When we got back to the Bull Pen, I called up Cruse's clerk. "Say, that new boy will be in pretty soon to reorder the coal for the filter bed. Send the purchase order on through—the Old Man'll sign it."

Next month, the normal workings of Murphy's Laws hint of the supernatural until the old Man uses his head.

Picture courtesy Automobile Club of Buffalo, New York

The race was won, an era begun...

To the curious crowd, it was Thanksgiving Day, 1895. To the Duryea brothers, it was D-Day.

For this was the day they would compete in America's first automobile race, from Chicago to Evanston and back. A race that would see only six of over 80 entries able to start . . . and only two able to finish.

At 7½ miles per hour, the Duryeas' car didn't exactly sweep across the finish line as it won . . . but it did sweep away the last obstacles to the automotive era.

Nor was it merely the automobile age which the Duryeas ushered in. For, as thousands and then millions of automobiles took to the road, petroleum fell heir to the job of powering them. Oil became the nation's number one source of energy.

So it is that Cities Service, which has grown up with the automobile, now is faced with the biggest demand for its products in history . . . a demand heightened by the development of entirely new gasolenes now at Cities Service stations.

These new gasolenes are years ahead of their time . . . fitting companions for the cars of the future which automotive men have brought us today. More importantly, they're typical of all Cities Service products, and symbolic of even finer petroleum products to come.

CITIES SERVICE

(To obtain more data on advertised products see page 158)

Do you know these words?

By B. H. WEIL

A regular department intended to help both administrators and operating men keep abreast of technical names and processes in the petrochemical field.

Silicone Polymers

Silicone polymers (pronounced **sihl**-ih-kone) are fluids, resins, and rubbers that have become of considerable industrial importance in the past 15 years. They are unusually heat-stable (hence can be used over a wide range of temperatures), are water repellent, are resistant to oxidation and weathering, and have good dielectric properties. They are petrochemicals in the sense that many of the organic groups that can be attached to the silicon atoms (in the silicon-oxygen chains) are themselves made from petroleum or natural gas.

The silicone rubbers, for example, are usable over a wide range of temperatures (-130 to 500°F) for such applications as stationary seals for high-temperature oil lines, high-temperature caulking compounds, special-purpose gaskets and electrical tapes, conveyor belts for foods, etc. The silicone resins find use in making glass-cloth laminates, electrical-insulating varnishes, and protective coatings. The silicone fluids are employed as diffusion-pump media, defoamers, lubricants, etc.

Basic raw materials for the crude chlorosilane intermediates used for many of the silicone polymers are metallic silicon and methyl chloride. The latter is a petrochemical produced by chlorination of natural gas. Other organic chlorides which find commercial use include chlorobenzene, producible from reformate-derived benzene.

The silicone polymers are expensive, so have been used chiefly where less-expensive materials cannot suffice. In any field, there is always room for specialty materials. More will certainly be heard about them.

Polycarbonates

Polycarbonates, pronounced "**pahl**-ih-**car**-bohn-ates," are interesting new plastic materials which are potentially important as the basis for commercial films, fibers, and protective coatings. They are transparent, colorless, and possess good electrical and mechanical properties. Their formula is a bit complex; it centers around a carbonate grouping (-O-CO-O-) which is interspersed in the polymer chains between units consisting of diphenyl alkane (groups containing two benzene rings separated by at least one carbon atom).

Polycarbonates are not yet commercial materials, but reports have it that "feverish" work is in progress on them, both in Germany and in this country. In addition to their other properties, the polycarbonates are said to have relatively high melting points (300-600°F), low permeability to gases, and excellent resistance to acids and strong oxidizing agents. However, they display only limited resistance to strong alkalies, ammonia, and amines.

The polycarbonates are formed by reaction of a ketone (compound containing a -CO- unit) with a phenol or phenol derivative (compound containing a benzene ring to which an -OH group is attached), then carbonate linkage of the intermediate by treating with phosgene ($COCl_2$) or a dialkyl carbonate. For example, reaction of phenol (C_6H_5OH) and acetone (CH_3COCH_3) yields HOC_6H_4-$C(CH_3)_2$-C_6H_4OH (bisphenol), and this HO-R-OH structure becomes $(\text{-O-R-O-CO-O-R-O-CO-})_x$ when treated with phosgene (R standing for the diphenyl alkane group).

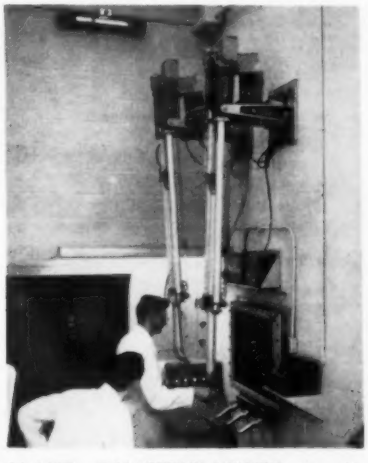
The polycarbonates will very likely form a new family of petrochemicals, since many ketones and phenols are derived from petroleum and natural gas, as described in previous installments of this series. They are certainly new materials of unusual interest.

Mr. Weil is chief editor of Esso Research and Engineering Co.'s Technical Information Division. He was until recently with Ethyl Corp's Research & Engineering Department.

NEWS in VIEWS

RADIOACTIVE COBALT starts on its way to Cities Service's new Cranbury, N. J., research labs, from . . .

AEC's Upton, N. Y. facilities. Truck in foreground carries 3-ton shield housing 3-lb source, which . . .



SLAVE MANIPULATORS handle easily at Cranbury labs. Total shipment from AEC emits 5000 curies.

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Petroleum Clip-n-File ENGINEERING

Instrument Terminology

This is the last of the three successive Engineering Data Sheets that comprise a glossary of instrument terms. Defined are terms commonly used in describing automatic control systems and the techniques involved.

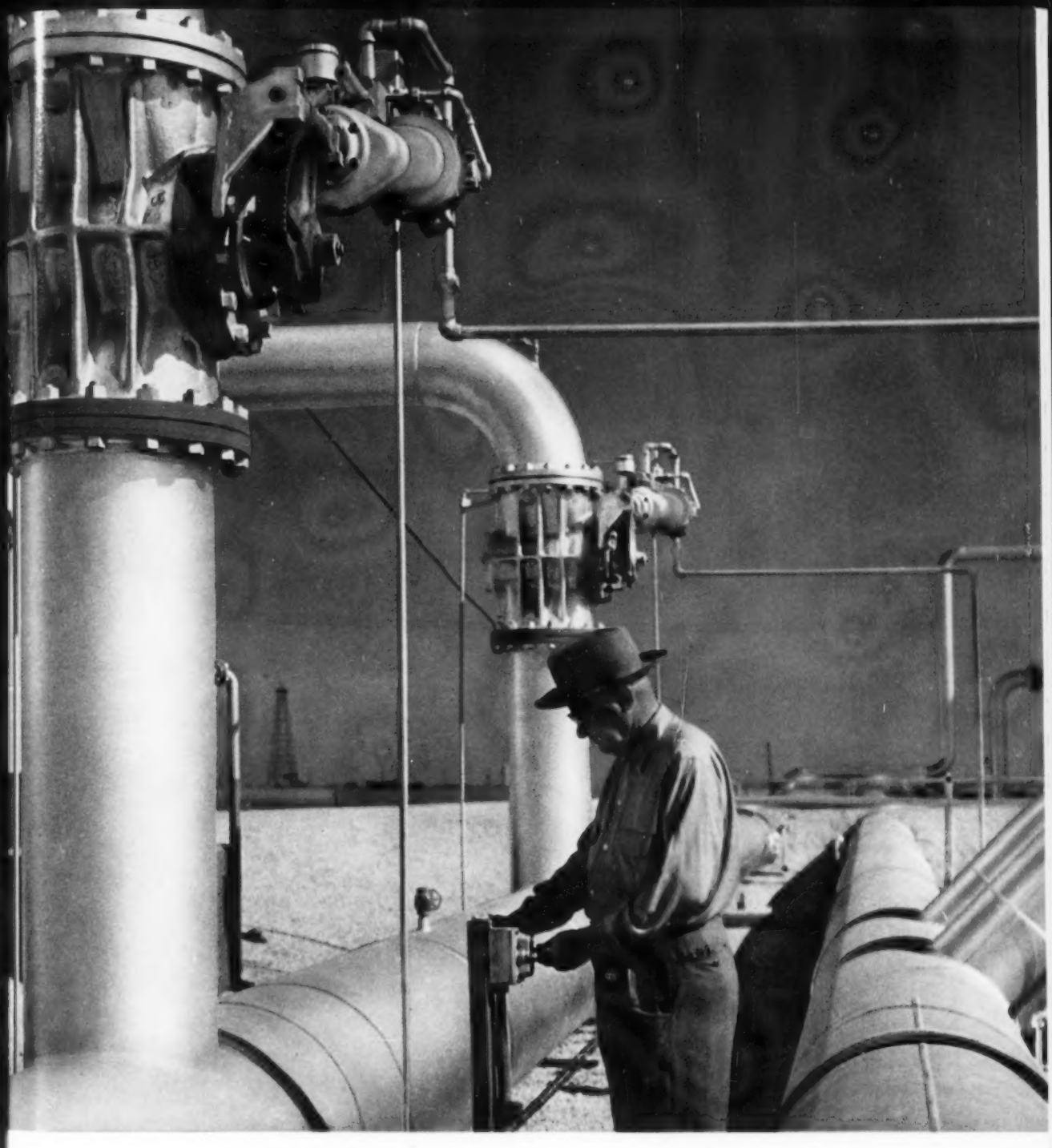
The purpose of this glossary of instrument terms is to help the average operating man understand some of the language used by control engineers, and to break through the semantic curtain which sometimes separates operations and instrumentation.

Term	Definition
Radiation	Energy propagated through space or a material medium as waves. Used in many forms such as infra-red, visible light, ultraviolet and gamma rays for analysis and measurement.
Radioisotope	A type of atom which spontaneously disintegrates with the emission of electromagnetic radiations.
Raman effect	A phenomenon used in the analysis of molecular structure and behavior. It is a change in the apparent optical spectrum of a material due to the scattering of light by the molecules of transparent fluids and solids.
Random noise	Electrical distrubances of nonuniform and irregular amplitude, phase and frequency which may interfere with signal reception.
Rangeability	A ratio of the maximum to minimum flow of a control valve, within which flow characteristics are maintained to stated limits.
Rate of action	Controller action in which there is a continuous linear relationship between rate of change of the controlled variable and the position of the final control element.
Rate of reaction	The speed with which a control instrument reacts to a detected signal.
Ratio control	A type of control which uses a measurement of one variable to adjust the control point for a second variable. Often used for proportioning the flow of an additive based on the total flow.
Reaction lag	A lag in a process required for completion of a reaction before its result can be measured.
Readout	The visual indication and printed record of any process variable.
Receiver	That part of an instrument system which receives a signal from a transmitter and often converts it to another form.
Recorder	An instrument whose primary function is to make a continuous record of a process condition.
Recorder-controller	An instrument which combines the function of recording a condition with that of controlling it also.
Reference junction	The cold junction of a *thermocouple;* the free ends of the two dissimilar wires across which a voltage is generated by a temperature difference.
Reflectivity	That fraction of radiant energy which is reflected from a surface exposed to uniform radiation.
Refraction	The bending of a light ray or other radiation as it passes from one medium to another.
Regulator	A device which measures a variable and limits the deviation of this value from a selected reference.
Relay-operated	Defines a measuring or controlling element which uses additional energy for supplementing or amplifying its final action.
Repeatability	A measure of the ability of an instrument to reproduce the same results when subjected to the same test conditions.
Reset control	A type of control response which moves the valve in proportion to the deviation of the variable from the set point.
Reset rate	A measure of automatic reset response, expressed as the number of times per minute that the automatic reset duplicates the correction caused by deviation of the pen.
Resistance bulb	A wire-wound resistor used to measure temperature by its change in electrical resistance; it is usually connected to a Wheatstone bridge for measuring the change in resistance.
Resolution	A term denoting the process of separating closely-related values, such as the smallest change in wavelength which a spectrometer can differentiate.
Resolution sensitivity	The minimum change in a measured variable which will produce an effective response in an instrument.
Resonance, magnetic	A method of analysis using an oscillatory magnetic field to distinguish otherwise similar molecules.
Response	A quantitative expression of the output of an instrument (or system) as a function of an input under explicit conditions.
Response time	The time required for an instrument to achieve a specific percentage of a change which it is going to make due to an abrupt change in a measured quantity.
Scale error	The difference between the true and indicated value of a variable.
Scale factor	A measure of the sensitivity of a galvonometer; the ratio of the current through, or the voltage across, the terminals to the deflection.
Scanning	An electronic means of automatically and continuously monitoring process variables.
Second derivative control	A control response which gives a rate of movement of final control element proportional to the acceleration of the change in deviation.
Self-operating controller	A controller which uses the power to the measuring system, such as pressure, without amplification by another power source to operate the final control element.
Selsyn	A trade name (General Electric) for *synchro.*
Sensitivity	The ratio of effect to cause in an instrument, such as the ratio of valve movement to pen movement.
Sensitivity threshold	The lowest level of a measured variable which will produce an effective response from an instrument.
Sensor	Any device for measuring a variable and converting it into a signal with a fixed relationship to the variable.
Servo	An auxiliary power-operated amplifier used in instruments to position the final control element under the control of the measuring element.
Servomechanism	A type of servo used to control a mechanical function.
Set Point	The value of the process variable which is to be maintained by control action. This term may also refer to the pointer which indicates this value on an instrument.
Shunt	An electrical bypath which reduces the sensitivity of galvonometers by dividing the current.
Signal	An indication—visual, audible, electrical, etc.—used to convey information in an instrument system.
Signal-to-noise ratio	The ratio of the value of a signal to that of *noise* in the system.
Simulation	The representation of a physical system by a computer and related equipment.

For more definitions, turn the page . . .

Instrument Terminology (continued)

Term	Definition
Snap action	Abrupt changes in current in a control circuit due to the abrupt separation or closing of snap-action switches.
Snubber	A device for absorbing or dissipating pressure surges before they reach and damage pressure gages or other instruments.
Spectrometry	The measurement of wavelengths of various radiations, whose absorption or passage by any material is unique and serves as identification.
Spectrophotometry	The use of light for determining color, turbidity, opacity and other characteristics of fluids.
Speed of response	The time required for an instrument to react to a change in a process variable.
Square-root compensation	The ability of a flow meter to give a direct reading of flow on a pressure drop measurement.
Stability	The tendency of an instrument or its components to retain constant characteristics.
Standardize	To adjust an instrument so that it will react similarly with a selected standard instrument.
Static error	The deviation of an instrument reading from that of the absolute value of a static variable.
Strain gage	A type of transducer which converts force into an electrical signal.
Step input	Release of a signal or power input to a system in definite steps, rather than as a continuously varying value.
Strip chart	A continuous chart on which a recording instrument places a permanent record, as opposed to a definite-period circular chart.
Superconductivity	The ability of some alloys and metals to conduct electricity at very low temperatures without resistance; used in one type of computer.
Suppressor	A device used in electric or electronic circuits to prevent undesired actions, such as sparking or secondary emission.
Sweep	A steady change in the value of a quantity in order to depict a characteristic.
Synchro	An electrical system for remote control or indication.
Tailing effect	A fault of transmission systems which continues a signal after the input condition has ceased.
Tandem	An arrangement of system components in which the output terminals of one network are directly connected to the input terminals of another network.
Telemetering	The measurement and transmission over a considerable distance of variable quantities.
Thermal detector	Any device which uses radio-frequency current, voltage or field to alter its electrical characteristics as a result of heating. Examples include thermocouples and thermistors.
Thermistor	A resistance element of semi-conducting material in which the electrical resistance decreases rapidly as the temperature increases—opposite to the behavior of metals.
Thermocouple	A temperature measuring device composed of two pieces of different metals, welded or soldered together at one end. When the temperature changes at the welded junction, an electromotive force is generated and appears at the free ends. This is translated into a temperature reading.
Thermometry	The measurement of temperature below 1000°F, usually with an instrument that uses the expansion of matter by heat as a relative indication.
Thermopile	A closed circuit of several thermocouples connected in series to multiply their effect, used for detecting and measuring small temperature differences.
Thermostat	An apparatus for maintaining and keeping constant any practicable temperature.
Thermowell	A cavity within a vessel or line, but sealed off from it, for the purpose of inserting a thermocouple or thermometer for temperature measurement.
Threshold value	The minimum input which will produce a corrective action in the power element of an automatic controller.
Throttling control	A type of control which can position the final control element at any position between maximum and minimum limits.
Throttling range	See *proportional band*
Time delay	The time required for a specific current or voltage to travel through a circuit.
Time gate	A transducer which permits output only during certain time intervals.
Torque balancing	A method of measuring electrical forces by using their magnetic effect to twist a wire.
Totalizing	The operation of an indicating instrument to convert readings into total value for a certain period of time, such as total flow rather than instantaneous flow.
Tracking	The process whereby an index follows the variation of a quantity by means of an inverse feedback loop.
Transducer	A device which receives energy (or a signal) from one system and transmits it to another. The input and output energies may be similar or different in form.
Transient conditions	Process conditions which vary widely and have not reached a steady state.
Transistor	An electronic device, using a semi-conducting material, for rectification or amplification of a signal. It is replacing vacuum tubes in many applications.
Transfer lag	A lag in process response often due to delay in overcoming heat resistance and capacitance.
Transit time	The time required for electrons to travel between a given pair of electrodes.
Transmitter	A device that modulates a separate power source (pneumatic or electric), in accord with changes in a measured variable, and transmits a corresponding signal over some distance.
Transportation delay	See *dead time*
Two-position control	A type of control in which the final control element can be positioned only at a maximum or minimum position.
Turndown	The ratio of normal maximum flow to minimum controllable flow through a final control element.
Ultrasonic	Refers to elastic waves above the audible frequency range, i.e., above about 15 kilocycles. Used in measuring thicknesses of metals, among many other uses.
Ultraviolet	Refers to electromagnetic waves at a frequency range just above visible light, i.e., about 4100 to 150 angstroms. Used as a source for spectroscopic analysis.
Valve positioner	An auxiliary air system on air-operated control valves which applies full air pressure on the motor diaphragm, or exhausts air from it, until the valve stem is positioned as requested by the controller output pressure.
Variable	A physical quantity which is not constant but varies with time.
Varistor	A semi-conductor device which has a non-linear resistance that depends on applied voltage.
Vernier scale	A greatly enlarged scale for more accurate reading or adjustment of a section of the normal full-range scale of an instrument.
Wheatstone bridge	One of the simplest bridge networks for measuring electrical resistance, with four resistances arranged in a diamond circuit and a galvonometer connected across two resistances.
X-Rays	Electromagnetic radiation with wavelengths from 0.1 to 100 angstroms; used for analysis of crystal structures and internal examination of physical bodies.
Zero-beat	A condition where two compared frequencies are exactly the same.



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Rockwell-Nordstrom valves are available in a complete range of sizes and pressure ratings with electric, pneumatic and cylinder operators. They cost no more to buy—often less—than ordinary valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Available at leading suppliers . . . everywhere.

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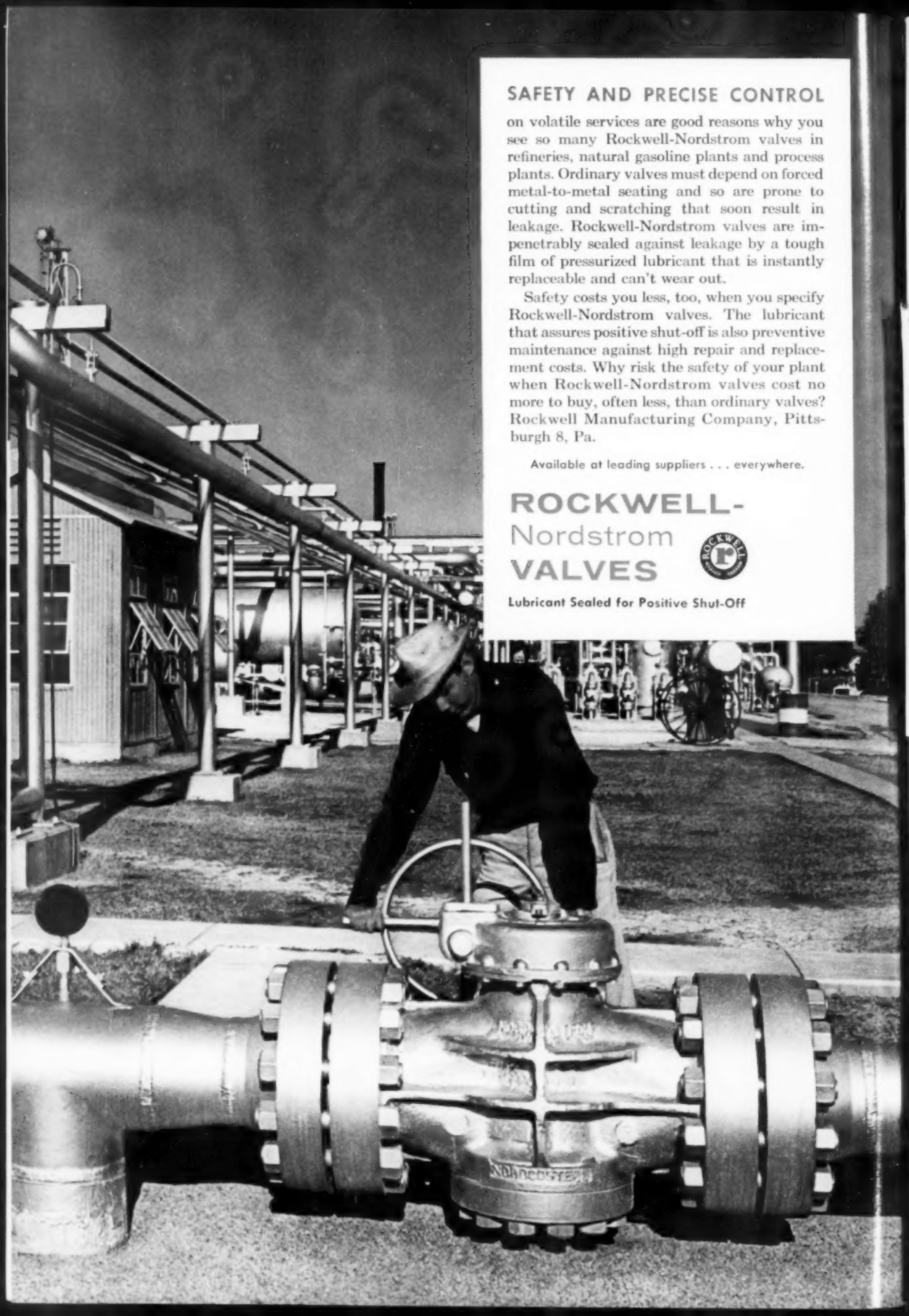
VALVES

Lubricant Sealed For Positive Shut-Off



SAFETY AND PRECISE CONTROL

on volatile services are good reasons why you see so many Rockwell-Nordstrom valves in refineries, natural gasoline plants and process plants. Ordinary valves must depend on forced metal-to-metal seating and so are prone to cutting and scratching that soon result in leakage. Rockwell-Nordstrom valves are impenetrably sealed against leakage by a tough film of pressurized lubricant that is instantly replaceable and can't wear out.

Safety costs you less, too, when you specify Rockwell-Nordstrom valves. The lubricant that assures positive shut-off is also preventive maintenance against high repair and replacement costs. Why risk the safety of your plant when Rockwell-Nordstrom valves cost no more to buy, often less, than ordinary valves? Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed for Positive Shut-Off

Mr. Smith

Mr. Graves

Mr. Adam

Mr. Bradshaw

Four refining changes at Magnolia

PROMOTIONS have been announced in the refining division of Magnolia Petroleum Co. P. L. Smith has been named general manager of the division. F. M. Graves has been promoted to assistant general manager of the division, and R. C. Adam has replaced Smith as manager of operations at the Beaumont refinery. W. M. Bradshaw has been made executive assistant.

Smith was formerly manager of operations, a post he was given early in 1956. Before that he directed the refinery's technical department for 17 years.

As assistant manager Graves moves up from executive assistant. He has been with Magnolia for 22 years. At one time he was assistant chief chemist.

For the past year and a half Adam has served Magnolia as manager of technical services. Previous to this he was chief process engineer in the technical department.

Bradshaw has been with the company since 1921. In 1941 he became a statistician in the economics department. He was made a staff assistant in the general superintendent's office several years later, and he took his last job, an aide to the executive assistant, in 1956.

Ernest Peterson has transferred to the Esso Standard Oil Co.'s Bayway refinery as coordinator of raw material supply in the supply and distribution department. He succeeds **Louis Davis,** who transferred recently to the International Petroleum Co. at Lima, Peru.

Jack Trout, formerly in Bayway's technical service division, has moved to Esso's Bayonne refinery as a supervisor in its fuel terminaling division. Trout was head of the Bayway crude evaluation group, and has been succeeded there by **Ross Quincy.**

At Bayonne, the transfer of Trout to fuel terminaling moves **Gordon Seeler** up to head of the fuel terminaling division.

Edgar B. Chiswell has been appointed executive secretary of California Chemical Co., a new chemical subsidiary of Standard Oil Co. of California. Chiswell was formerly manager of process research and development for California Research Corp.

He joined Standard in 1937 as an assistant engineer at the Richmond labs. This was shortly after he received his doctorate from M.I.T. Since then he has been division supervisor of process design, chief design engineer and chief process engineer, prior to becoming process manager.

Dr. M. W. Tamele, associate director of fundamental research activities at Shell Development Co., has taken up new duties with Shell Research Laboratories in Amsterdam, Holland. He is assisting the director of research in planning.

D. P. Stevenson succeeds Tamele at Emeryville, and **J. W. Otvos** replaces Stevenson as head of the chemical physics department.

Tamele has been with Shell Development since 1929. He organized the colloid chemistry department in 1935 and became an associate director of the lab in 1945. He holds a Ph.D. in chemistry awarded to him in 1924 by Charles' University of Prague.

Stevenson joined Shell in 1942 in the physics department. He became assistant department head in 1950 and head of the chemical physics department in 1952. He received a B.S. in chemistry from the University of California in 1934 and a Ph.D. in chemistry from Princeton University four years later.

Otvos joined the company in 1946 as a chemist in the physics department. In 1952 he was made assistant head of the spectroscopic department, and in 1956 was made assistant head in the chemical physics department. He holds a B.S. in biochemistry from Harvard, class of 1939, and a doctorate in physical chemistry from the California Institute of Technology in 1943.

New directors of the Western Petroleum Refiners Association, elected at the group's recent annual meeting, are as follows:

C. R. Brown, Tidewater Oil Co., Tulsa,

L. W. Robbie, Republic Oil Refining Co., Texas City,

R. G. Sanders, Magnolia Petroleum Co., Beaumont, and

E. M. Stone, Empire Petroleum Co., Denver.

In addition, **Paul D. Williams** was re-elected secretary-treasurer of the group.

W. G. Eddleman has been promoted to assistant chief engineer, office, at Shell Oil Co.'s Houston, Texas, refinery. He was senior project engineer at the Wood River, Ill., refinery.

Mr. Eddleman

Eddleman has served as industrial, planning, area and project engineer with Shell during his 10 years at the Wood River refinery. He was graduated from the University of Illinois in 1946 with a B.S. in mechanical engineering.

Jennings B. Hamblen has been named safety director for American Oil Co., succeeding L. E. Mitchison, retired.

L. Wayne Hicks has been promoted to assistant director of the general engineering department, with headquarters at Texas City.

Hamblen was graduated from the University of Wisconsin with a B.S. in chemical engineering. He later received a master's in the same subject from M.I.T. He joined the research department of Standard Oil Co. (Ind.)

in 1927, in 1935 transferred to Amoco at Destrehan, La., and in 1947 became general manager of manufacturing for Pan-Am Southern Corp., an affiliate. In 1951 he was named Pan-Am safety director and in 1956 became assistant director of safety for Amoco.

Hicks joined Amoco in 1948, shortly after his graduation from Texas A. & M. with a B.S. in mechanical engineering. In 1955, he was senior construction and mechanical engineer at Texas City when he was transferred to Yorktown as project inspector for the new Amoco refinery there.

Appointments to the posts of staff engineer and shift foreman at the new Delaware refinery of Tidewater Oil Co. were announced recently. New staff engineers are:

William E. Baston, in reforming and extraction,

Joseph Dunphy, in oil dispatching,

William H. Graf, in the crude area,

Charles S. Joanedis, in desulfurizing and hydrogen,

Charles McCloud, in the coking area,

Frank J. Menton, in alkylation-polymerization area,

Robert E. O'Sullivan, in the utilities and sulfur recovery section, and

Joseph H. Schramm, in the cracking area.

New supervising foremen were as follows:

Lyle C. Pratt, Bernard E. Woods, Russell S. Pease, and **Louis G. Fuller,** all named shift foremen of the crude-coking-cracking areas,

William F. Limber, Edward F. Naus, Earl J. Borde, and **John J. Scott,** who were made shift foremen of the alkylation-polymerization-reforming-desulfurizing areas.

Of the engineering group, Baston, Dunphy, Graf, Menton, O'Sullivan, and Schramm all were at Tidewater's Bayonne refinery previous to this appointment. Joanedis came to the company last August from the Du Pont Co., and McCloud was transferred in October from the Drumright, Okla., refinery.

Of the foremen, Pease, Fuller, Limber, Borde and Scott began at the Avon, Calif., refinery. Woods and Naus were at Bayonne.

C. W. Stose has been appointed general superintendent of the process division at Atlantic Refining Co.'s Philadelphia refinery. The division was formed in a recent reorganization of the refinery.

W. O. Hoffmann has been named general superintendent of the newly formed services division, and **G. K. Marple** has succeeded Hoffmann as superintendent of the mechanical inspection division.

Stose was appointed assistant to the plant manager in 1952, general manager of crude purchases and sales a year later, and placed on special assignment earlier this year.

Hoffmann was made assistant superintendent of the acid and drainage department in 1944 and superintendent in 1948. He was next made assistant superintendent of lubricating, superintendent of the chemicals department in 1952 and mechanical superintendent in 1956.

Marple joined Atlantic in 1947 as shop section supervisor in the mechanical department. He became assistant superintendent of this department in 1952.

Mr. Christison

Mr. Sailor

Fellowships have been awarded two technical men at Socony Mobil Oil Co. **David Christison,** assistant director of the technical department at the Paulsboro refinery, has received a Sloan fellowship, entitling him to join the executive development program of the Massachusetts Institute of Technology.

Robert A. Sailor, technologist with the research and development lab at Paulsboro, has been given an Incentive Fellowship award, a company award given each year to a laboratory employe of outstanding ability and inventiveness. The company pays the person's full salary for up to three years while he carries on advanced studies. Sailor will work toward his doctorate in chemical engineering at the University of Delaware.

Christison began with Socony in 1943, after receiving a degree from M.I.T. in chemical engineering. He worked in Brooklyn and Paulsboro laboratories and transferred in 1953 to the planning section of the refinery's technical department, assuming his present post in 1956.

Sailor took highest honors when he graduated with a B.S. in chemical engineering from Lehigh University in 1953. He joined the laboratory staff that year as a junior technologist in the lubricants section of the products division. He was transferred to the process development division a year later.

Malcolm T. McCants has opened consulting engineering offices in Houston. He was last with Great Northern Oil Co., St. Paul, Minn., as plant manager. He supervised the design and directed construction and operation of the refinery.

William J. Katt and **Milton Welhoelter** are group leaders in the systems engineering section newly organized in Monsanto Chemical Co.'s research and engineering division. The section is studying the dynamics of chemical process systems and their control. Other group leaders in the section are Dr. Joel O. Hougen, formerly of Rensselaer Polytechnic Institute, and Dr. Theodore J. Williams, formerly with the U.S. Air Force Institute of Technology. Appointments of the last two men were announced several months ago.

Katt was previously manager of the instrumentation and electrical engineering section of Monsanto's organic chemicals division. Welhoelter was formerly senior technologist with the research and engineering division.

Six new members have been added to the Military Petroleum Advisory Board, a panel of men from the oil industry set up to advise the Departments of Defense and Interior about oil and gas matters. New members are as follows:

Charles P. Baker, Mobil Overseas Oil Co., New York,

Walter E. Caine, Texas Eastern Transmission Corp., Shreveport, La.,

Albert R. Denison, Amerada Petroleum Corp., Tulsa,

Jake L. Hamon, Dallas,

Herschel Hyde, Tidewater Oil Co., San Francisco,

Frank A. Watts, Humble Oil & Refining Co., Houston.

Reappointed to the board for another three-year term were:

John H. Carson, East Ohio Gas Co., Cleveland,

Stewart P. Coleman, Standard Oil Co. (N. J.),

James Terry Duce, Arabian American Oil Co., Washington, D. C.,

W. W. Keeler, Phillips Petroleum Co., Bartlesville,

A. W. Lundstrum, Ohio Fuel Gas Co., Columbus, Ohio,

George L. Mateer, Cities Service Refining Corp., Lake Charles, La.,

Richard E. Nelson, Jr., Standard Oil Co. (Ind.), Chicago.

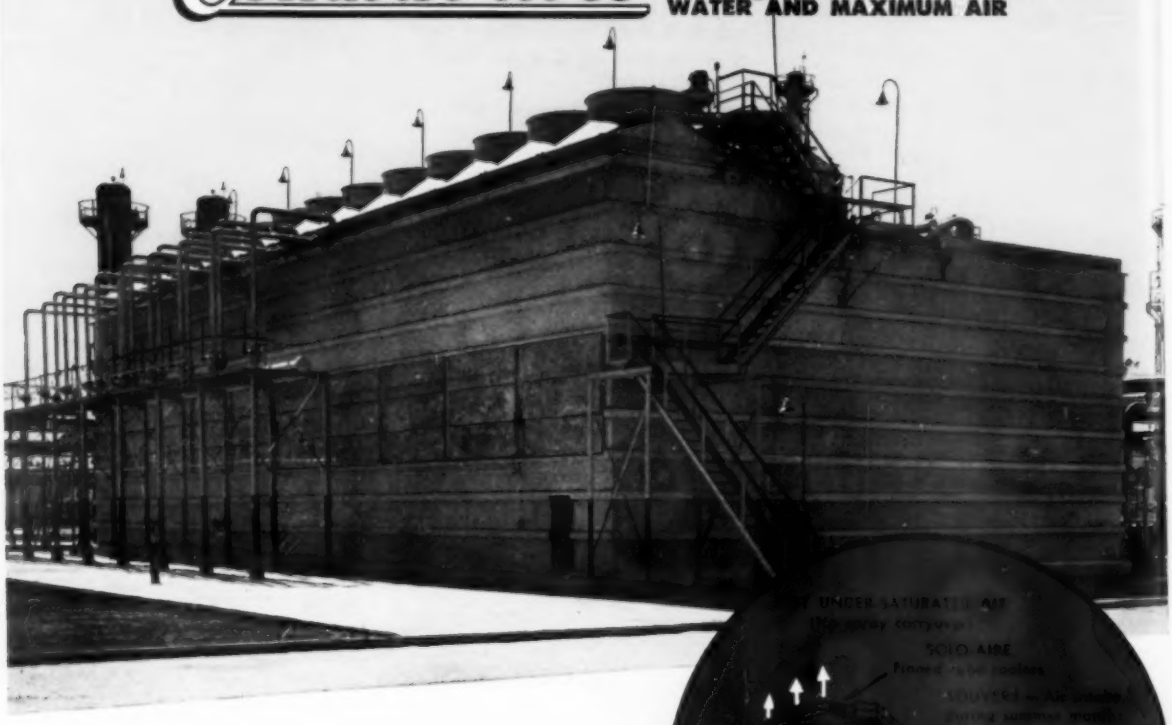
what's your plant water problem?

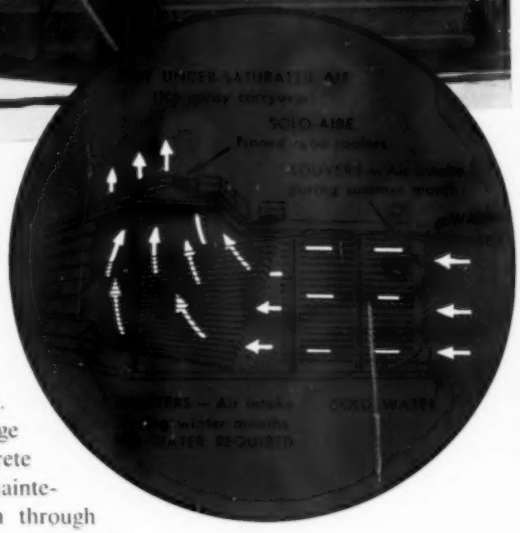
■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

HUDSON Combin-aire

LOW TEMPERATURE COOLING USING COMBINATION OF MINIMUM WATER AND MAXIMUM AIR





Where quantity or quality of water is low, and ambient air temperatures too high to permit direct cooling with air, process plant designers find the modern solution in Combin-aire. In addition to large savings through minimizing water consumption and eliminating water treatment, Combin-aires incorporate many other advantages.

The Combin-aire pictured above, installed in a large gas processing plant in northern Mexico, is of concrete construction, eliminating fire hazard and minimizing maintenance. As shown in the cut-away drawing, air is drawn through cooled water by fans located on top of the structure. The air, precooled and washed free of solids by the water, flows across the finned tube coolers, and leaves the top of the Combin-aire at elevated temperature under-saturated with water vapor. Mist carryover, condensation from effluent air, and air recirculation are thus eliminated. Combin-aires are installed adjacent to process equipment, minimizing piping and concentrating operating area.

In winter, air flows directly to the Solo-aire finned coolers, water circulation being unnecessary. Where water is required for shell and tube units or atmospheric sections, such water may also be cooled in the Combin-aire unit, eliminating the conventional cooling tower.

In addition to Combin-aire units, Hudson manufactures water cooling towers, air-cooled and water-cooled coolers and condensers, and is experienced in plant layout, piping, and water treatment. We shall be glad to assist prospective plant owners in making overall comparisons of first costs and operating costs for complete cooling systems using various combinations of equipment.

HUDSON

ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

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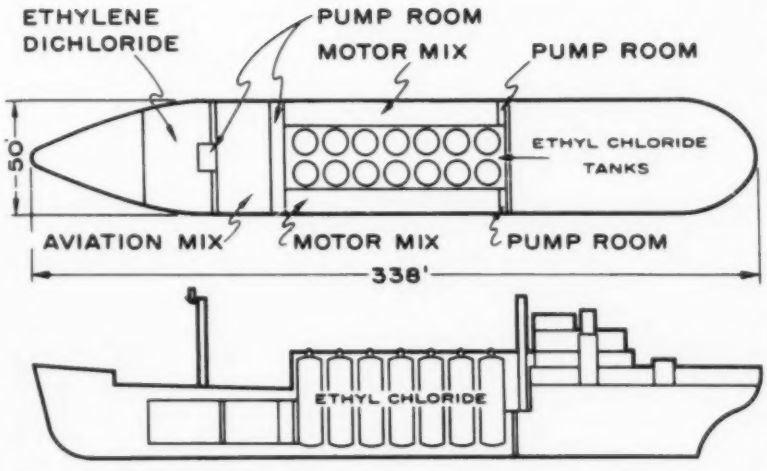


'New' ship carries TEL in bulk

A CONVERTED dry cargo ship is now in service for Du Pont Co. to carry tetraethyl lead in bulk. The first ship of its kind, the M.V. Petrochem will haul for Du Pont's Petroleum Chemicals Division from the Deepwater Point, N. J., plant to portside facilities in Beaumont, Texas. Expanded terminal and blending facilities there will handle the ship's cargo.

As the illustration shows, 14 upright cylindrical pressure vessels on the ship will hold ethyl chloride, and six special steel tanks are for TEL. Another compartment will hold ethylene dichloride. TEL will be carried to the Beaumont docks, and the ship will then pick up raw materials on the Gulf Coast and return to New Jersey. The 6000 dwt ship can make the round trip in less than three weeks.

An unusual feature of the tankship is that it has unloading equipment with swingline connections mounted on the ship. The TEL tanks are part of the ship's structure—welded to the ribs—and the tank surfaces are exposed for inspection. As a safety measure the TEL tanks have a separate bilge system, to prevent contamination of the normal bilge in the event of spillage. The ship is divided into six liquid-tight compartments by five cofferdams, another precaution. Air samples from below decks can be taken while standing above deck, and the air below decks is changed every three minutes.

F&P to market Gilbarco gage

Fischer & Porter Co., Hatboro, Pa., has agreed to market the Gilbarco electronic tank gage, made by the Gilbert & Barker Manufacturing Co., West Springfield, Mass. The gage can be used with F&P's automatic data handling systems.

Gilbarco's gage uses a servo-operated probe to detect tank liquid level. High frequency signals move the sensing element with the changes in liquid level.

Fischer & Porter also has taken over the manufacturing of the Gilbarco null balance tank level receiver.

Mason-Neilan creates new posts

A new post of general sales manager and three new regional sales headquarters have been established by Mason-Neilan, a division of Worthington Corp.

A. Blair Powell has been named general sales manager of the division, with headquarters at Norwood, Mass. He is a 1934 graduate of the University of Pittsburgh, with a B.S. degree, and joined Mason-Neilan in 1937 after holding two jobs in industry. In 1947 he was appointed manager of the Pittsburgh office.

Warren F. Priest has been named eastern regional manager, over offices in Boston, Buffalo, New York, Skaneateles, Philadelphia, and Pittsburgh.

E. Putnam Head becomes southeastern regional manager, supervising Atlanta, Birmingham, Charlotte and Jacksonville offices.

Alex M. Thackara has been promoted to west coast regional manager with responsibility for Los Angeles, San Francisco, Seattle, Denver, Salt Lake City, El Paso and Phoenix. In addition, Malcolm D. Duncan has been appointed manager of a new Jacksonville office.

How to beat the draftsmen shortage

When Rockwell Manufacturing Co. needed draftsmen at the new Statesboro, Ga., plant of the Meter and Valve Division it decided to try something new. Ralph Purcelli, general manager of the division, set up a training program for all high school graduates who were interested. Many applied and took the aptitude test to enter the course. Men from all parts of the division are now attending classes—not only in drafting, but in other technical subjects as well.

Classes are conducted by Dr. Donald F. Hackett, Georgia's Teachers College; Howard Rittenhouse, chief engineer; and Curt Steinberger, chief draftsman.

Mexico shifts top officers

W. Basil Leach was elected president of the Mexico Refractories Co. at a meeting of the board of directors. John B. Arthur, founder of the firm, was made chairman of the board and chief executive officer.

Mr. Leach

The new office of executive vice-president was filled by C. A. Smith, vice-president and chief engineer. Carl H. Bachmann, production manager of the Mexico plant, has been made a vice-president.

Davison to produce catalyst

Commercial-scale production of polyolefin catalyst will begin this year at Davison Chemical Co. The catalyst, produced under license from Phillips Petroleum Co., has been turned out until now in pilot plant quantities.

Davison is building a plant at Cincinnati to make the catalyst at an initial rate of 8000 lb/day. The plant will produce enough to supply Phillips licensees, which include the Polymer Chemicals Division of W. R. Grace Co. This division has a polyolefin plant

under construction at Baton Rouge, La. Grace owns Davison Chemical as well. Polyolefins are some of the fastest expanding petrochemicals.

The new Davison plant in Cincinnati is next to the company's cracking catalyst plant.

Mr. Allen

Mr. Broxham

Allen, Broxham moved at Graver

S. E. Allen has been promoted to vice-president and general manager of all Graver Tank & Manufacturing Co. operations. W. M. Broxham has been named vice-president and general manager of the plate and alloy products division.

Allen was formerly general manager of plate products. Before joining Graver three years ago he had been vice-president of manufacturing for Pusey & Jones. His new responsibilities include supervision of all Graver Tank's plants as well as Graver Water Conditioning Co., Graver Mid-Continent Division, and Graver Construction Co.

Broxham's last post was sales vice-president of all Graver operations. He has been with the company for over 30 years.

Capacity at Foxboro to expand

Foxboro Co. will add a new structure on to its instrument manufacturing plant at Foxboro, Mass. This will expand production capacity by 50%. Construction begins in July. The new building will be 475x250 ft and will house a receiving department and all machining and finishing operations. A new warehouse will adjoin the factory addition. With 175,000 sq ft of space added, the firm will have a total of 475,000 sq ft of manufacturing space.

Completion of the new units is scheduled for early summer of 1958.

Houdry to take contract research

Houdry Process Corp. has formed a special contract research group at the Linwood research and development laboratories to undertake projects in other industries in addition to refining and chemical processing. So far, the company's R&D activities have been principally for clients and licensees in the petroleum and chemical processing industries.

The new service is expected to be especially attractive to companies concerned with solid state chemistry, fine chemical producers, heavy chemicals plants with special problems in hydrogen treating and catalysis, and plastics and rubber processors and manufacturers.

The new group will function directly under George F. Hornaday, associate manager of research and development. It will be headed by T. H. Milliken, former section chief in catalyst research and development. Milliken has also been active in the fields of atomic energy and ore processing, as well as process design. Section chief of contract research is Dr. Heinz Heinemann, former section chief in process research. Dr. Harold Shalit succeeds Heinemann in process research.

Project director of the group is Dr. J. J. Donovan, formerly project director in catalyst research. Donovan has also been chief chemist in ballistics research at Hercules Powder Co. and a consultant on atomic energy projects with Catalytic Construction Co. E. B. Cornelius succeeds him as catalyst research section chief.

Rockwell buys Republic Meters

Rockwell Manufacturing Co. has bought Republic Flow Meters Co. of Chicago, manufacturers of electronic and pneumatic instruments and process control equipment for petroleum, chemical, natural gas and other industries.

The acquisition brings the number of Rockwell's manufacturing plants to 23. Republic's operations are centered in Chicago, with sales offices or branches throughout the country.

Natural Gasoline group elects

New officers were elected to the Natural Gasoline Supply Men's Association at the group's recent annual meeting. They are:

President, James Dvoracek, Rockwell Manufacturing Co., Houston.

First vice-president, Hugh Sears, Alliger & Sears Co., Houston.

Second vice-president, R. P. Walker, Minneapolis-Honeywell Regulator Co., Oklahoma City.

Treasurer, Ray F. Riddle, Riddle and Rubbell, Tulsa.

Secretary, William F. Lowe, who is also secretary-treasurer of the Natural Gasoline Assn. of America.

B&W names new Tubular v-p

Babcock & Wilcox Co. has promoted James Anderson to vice-president in charge of sales of the Tubular Products Division. He was formerly general sales manager of the division.

Mr. Anderson

Vincent R. Barrord has been appointed manager of development sales for welded tubing. He is responsible for developing new product applications and new outlets for existing applications.

Anderson began with B&W in 1941 as a district salesman in the New York office. He was made assistant general sales manager of the division in 1948 and manager in 1953. He holds an M.E. Degree from Case Institute of Technology.

A graduate of Rensselear Polytechnic Institute, Barrord joined the company in 1949. A year later he was appointed a sales department engineer.

Personnel changes

Oakite Products, Inc.—John Mackesy, one of Oakite's San Francisco representatives, has been named winner of the David C. Ball Award for distinguished service to customers.

Floridin Co.—Norman H. Horton to manager of research laboratories, with headquarters at Tallahassee.

Chicago Bridge & Iron Co.—I. E. Boberg, chief engineer, to vice-president. He became chief engineer in 1945.

Quaker Oats Co.—William E. Hibbits to the New York technical sales staff.

Mason Neilan Regulator Co.—Robert O. Smith to New York district manager; Allan Gilchrist to sales engineer in the New York office; Robert Nickerson, from Norwood, Mass., to Chicago; John Mattes, Jr., to Chicago as a sales engineer; Harry Mattes and David Willardson to the Los Angeles sales engineer staff.

Ethyl Corp.—E. L. Tandrup to technical representative of the Detroit re-

Suppliers (Continued)

search laboratories. He will act as liaison between the labs and customers in West Virginia, western New York, and Pennsylvania.

Girdler Co.—O. R. Matzner to the sales engineering staff of the catalyst department.

Tretolite Co.—L. C. Camblin, associated with the oil industry since 1910, has retired.

Rockwell Manufacturing Co.—Dr. Charles J. Kentler, Jr., to New York district sales manager, and Charles B. Goff, Jr., to Pittsburgh district sales manager. Both are in the meter and valve division.

Ethyl Corp.—James M. Gill has been named manager of the plant still under construction at Pittsburg, Calif. He has been with Ethyl since 1948 and holds B.S. and M.S. degrees in chemical engineering from Louisiana State University.

Babcock & Wilcox Co.—J. Y. McCandless to manager of the Syracuse, N. Y., district sales office of the tubular products division.

Expansion, transition

Selas Corp. of America has organized an export division to service the company's European division, headquartered in Geneva. James S. Shute, who was assistant to the manager of the combustion equipment division, has been named head of the new division.

Babcock & Wilcox Co. plans to expand its Alliance, Ohio, research center to keep pace with company's activities in nuclear engineering research. A 15,700 sq ft extension will be added to the existing building.

Union Asbestos & Rubber Co. has appointed Precision Insulation Co., Houston, as a distributor of its high temperature insulation material.

Girdler Co. has expanded its catalyst plant to increase production rate and permit introduction of new catalysts in the company's line. Expansion represents a $450,000 investment, company estimates.

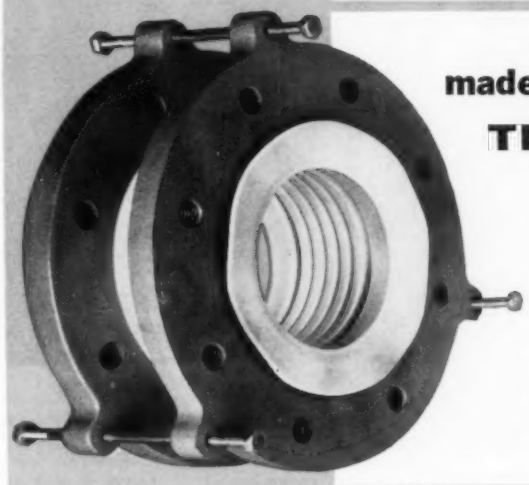
Obituary

Palmer Hughes, regional sales manager of the M. W. Kellogg Co., died recently at his home in Tulsa. He was 60. He began with Kellogg in the sales department in 1928.

Chemiseal Gaskets

AND ACCESSORIES FOR CHEMICAL PIPING

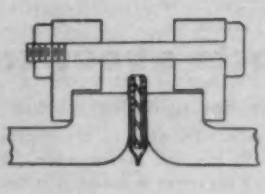
Chemical Expansion Joints and Flexible Couplings absorb shock and vibration, thermal expansion and contraction. Correct misalignment. Connect unlike piping ends and nozzles. Companion Products to the famous Garlock Rubber Expansion Joints. Catalog No. AD-137.



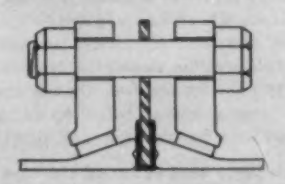
made of duPont TEFLON

impervious to

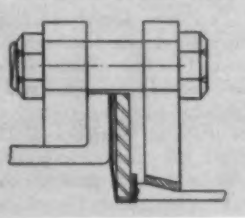
- **ACIDS**
- **ALKALIES**
- **SOLVENTS**



Chemiseal Jacketed Gaskets. Compressed asbestos sandwiched between woven asbestos and contained in Type 1 Teflon envelope. Ideal for sealing glass-lined steel connections. One of many types utilizing filler constructions ranging from soft woven asbestos to corrugated stainless steel, depending on service requirements. Catalog No. AD-154.



Chemiseal Jacketed Gaskets. Standard for Corning conical flanges. Neoprene filler. Type 2 Teflon envelope with flat surface fitting flush with pipe I.D., permitting free flow of medium. Catalog No. AD-154.



Chemiseal Reducers. A steel bearing ring provides rigidity. Resilient core assures safe seal at low bolt loads. Teflon Jacket protects and contains easy-to-handle single unit. Catalog No. AD-154.

United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*

OF THE GARLOCK PACKING COMPANY

(To obtain more data on advertised products see page 158)

NEW DEALER MEETING DEMONSTRATION—For a vivid demonstration of how carburetor icing causes stalling and how it can be prevented with DMF, ask our representative to show you the new single-cylinder engine assembly.

The new unit consists of a small ice tower and a 1.6-horsepower engine connected by a glass tube manifold. When ordinary gasolines are drawn through the tube, ice forms on a little metal valve and causes the engine to stall. But the addition of Du Pont DMF to the gasoline prevents any buildup of ice.

To convince your dealers and customers of the advantages of your new *no-stall* gasoline with DMF, we will be glad to help you build your own demonstration units.

Experiments reveal facts about carburetor icing

Recent experiments indicate that stalling due to carburetor icing occurs even in 55-degree weather. Moreover, they prove that Du Pont DMF (dimethyl formamide) provides the motorist with protection against this type of hazard and annoyance.

Stall-prevention is especially important in many cars having power brakes and power steering—both of which are less effective when the car-engine stops.

Dimethyl formamide proved effective in low concentrations

Its practical use concentration turned out to be under 0.10 volume per cent—in other words, less than three milliliters per gallon!

Long stalling season

Conditions under which your customers' cars can stall also became clearer. The "refrigerant" action of gasoline can lower the temperature of carburetor parts to freezing even on comparatively warm days. Generally speaking, temperatures from 22 to 55 degrees Fahrenheit can lead to carburetor icing when humidity is 65 per cent or higher.

Expanding de-icer market

Motorists are showing an ever-increasing interest in gasoline performance. By anticipating a greater demand next fall for gasolines which contain anti-stalling agents, you can increase the number of your cold-weather customers. Now is the time to plan for the day when temperatures begin dropping below 55 and carburetor icing begins.

Economy and reduced storage

DMF offers two important benefits—economy and minimum storage-space requirement. The low volume concentration that's needed represents a real saving in freight and blending costs. And, because of the high efficiency of Du Pont DMF, and the low concentration required, little storage space is necessary.

A Du Pont Petroleum Chemicals Division representative will be glad to give you more detailed information on DMF. You can contact him at any of our sales offices listed at right.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. ... RAndolph 6-8630
Cleveland 15—25 Prospect Ave. ... SUperior 1-1363
Denver 2—510 Mile High Center Bldg. . AComa 2-2347
Houston 2—
705 Bank of Commerce Bldg. .... CApitol 5-1151
Los Angeles 17—612 So. Flower St. . MAdison 5-1691
New York 20—
1270 Ave. of the Americas ..... COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . LOcust 8-3531
Pittsburgh 22—1 Gateway Center .. ATlantic 1-2933
San Francisco 4—111 Sutter St. .... EXbrook 2-6230
Seattle 3—4003 Aurora Ave. ..... MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. .... LUther 5-5578
In Canada—Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**—Ontario ..... HUdson 1-6461
In Other Countries—Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

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Better Things for Better Living
. . . *through Chemistry*

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & CO. (INC.) · Petroleum Chemicals Division · Wilmington 98, Delaware

"Impurities" help make ethyl chloride

A NEW and improved process for making ethyl chloride from hydrogen chloride and ethylene, using aluminum chloride catalyst, is described in U. S. Patent 2,76,875, issued to Ethyl Corp.

The major improvement in the process is the addition of effective quantities of acetylene (0.1-1.5 vol% on ethylene) and carbon dioxide (0.5-2 vol% on ethylene) to the process feedstock. These additives may be introduced with either stream, or with a combined stream of hydrogen chloride and ethylene.

Advantages cited for this process are: lower catalyst consumption, better ethylene utilization, higher conversion of ethylene to ethyl chloride, reduction of amount of polymeric by-products, better utilization of hydrogen chloride, and applicability of the process to ethylene streams with as little as 25-30 vol% ethylene content.

Making ethyl chloride—without (Case 1) and with (Case 2) CO_2 and C_2H_2

	Case 1	Case 2
Pressure, psi	125	125
Temperature °F	125	125
Ethylene stream:		
Ethylene, vol%	98	94
Carbon Dioxide, vol%	<0.1	0.9
Acetylene, vol%	0.005	0.6
Ethane, vol%	1	3
Methane, vol%	0.3	1.3
Hydrogen Chloride stream, vol%	97	97
Carbon Dioxide added, vol% on ethylene	0	1
Acetylene added, vol% on ethylene	0	0.6
Feed ratio, molal, HCl/C_2H_4	1.06/1	1.06/1
Hydrogen Chloride use:		
Utilization, lb/100 lb ethyl chloride	64.9	62.6
Efficiency, % conv. to ethyl chloride	87.5	90.4
Ethylene use:		
Utilization, lb/100 lb ethyl chloride	47.1	45.4
Efficiency, % conv. to ethyl chloride	92.5	95.8
$AlCl_3$ catalyst consumed, lb/100 lb ethyl chloride	1.0	0.60

No more patent stalling?

THE "20-year bill"—a casualty of recent past congresses—is back in the Senate hopper again. The proposal would limit the life of a patent to 20 years from the date the application is filed, or 17 years from the date of issuance, whichever comes sooner. The purpose is to eliminate stalling tactics by patent applicants.

Want to be a commissioner?

PATENT Commissioner Watson wants to retire at the end of 1957, but is having trouble finding an eminent patent lawyer to take over the job. Difficulties stem from a feeling of neglect of the Patent Office's growing needs by the Commerce Department; failure to raise salaries of the Commissioner and his top aides in last year's executive pay bill which raised salaries of other agency heads; and previous failure to lift salary scales of federal professional and scientific employes.

Bills to fill the gaps were introduced in April under joint sponsorship of Senator Joseph C. O'Mahoney (Democrat, Wyoming) and Senator Alexander Wiley (Republican, Wisconsin).

Senate bill pushes single court of patent appeals

A SINGLE court of patent appeals, drawing its membership from the Federal Judiciary on a rotating basis, is soon to be proposed for Senate action.

Basic reason for a single court is to eliminate present confusion of conflicting rulings on similar legal issues by different Federal Appelate Courts. It is also hoped that the single court would reduce widespread "forum" shopping and repeat engagements of the same suit before different federal district courts.

THE FOLLOWING PATENTS are selected from the Official Gazette of the U. S. Patent Office for Mar. 26, Vol. 716, No. 4; and Apr. 2, 9, 16, Vol. 717 Nos. 1, 2, 3. Copies of patents are available for 25¢ each. Order by patent number from the Commissioner of Patents, Washington, D. C.

Processes and methods

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Addition	make-up catalyst	moving granular cat.	Houdry Process Corp.	2,786,800
Alkylation	aromatics	olefin hydrocarbons	M. W. Kellogg Co.	2,787,648
Catalytic reforming	naphthas	fluid hydroforming system	M. W. Kellogg Co.	2,788,311
	naphthas	non-regen. fluid hydroforming	M. W. Kellogg Co.	2,787,583
Coking	heavy hydrocarbons	contin. moving coke particles	Lummus Co.	2,789,084

Continued on p. 144

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Coking & cat crack. . .	petroleum stocks	fluidized-bed system	Esso Research & Engrg. Co.	2,789,082
Deashing	hydrocarbon oils	water extraction	Esso Research & Engrg. Co.	2,789,083
Dehydration	isopropanol	azeotropic distillation	Esso Research & Engrg. Co.	2,787,586
Demethylation	methylbenzenes	silica-alumina cracking cat.	Socony Mobil Oil Co., Inc.	2,786,876
Desulfurization	petroleum coke	heating at 2500-3200°F	Esso Research & Engrg. Co.	2,789,085
Hydrochlorination	ethylene	reaction in liq. ethyl chloride	Ethyl Corp.	2,786,875
Hydrogenation	high-boiling hydrocarbons	fluidized hydrogenation cat.	Gulf Research & Development Co.	2,786,801
Manufacture	acetylene	high-temperature conversion of hydrocarbon gases	Lummus Co.	2,789,149
	alumina	acid and other treatments	M. W. Kellogg Co.	2,787,522
	alumina gel catalyst . .	contin. uniform aging & washing	Universal Oil Products Co.	2,787,599
	CO & H_2	underground gasification of coal	The Texas Co.	2,788,956
	carbon disulfide	fluid coke-sulfur vapor reaction	Esso Research & Engrg. Co.	2,789,037
	carbon disulfide	hydrocarbon-molten S & pebbles	R. E. Stanton	2,788,261
	ethylene	pyrolysis of alkyl hydrocarbons	Minister of Natl. Defence-Canada	2,786,877
	nitriles	aldehyde-ammonia reaction	Eastman Kodak Co.	2,786,867
	oxirane compounds . . .	H_2O_2 & tungstic acid cat.	Shell Development Co.	2,786,854
	silica-alumina catalyst	mixture of hydrogels & mulling	Esso Research & Engrg. Co.	2,787,600
	SO_2	conversion of acid sludge	Stauffer Chemical Co.	2,789,035
	sulfurized dipentene . .	bearing corrosion inhibition	Standard Oil Co. (Ind.)	2,787,613
	synthesis gas	non-cat., air-hydrocarbon react.	The Texas Co.	2,789,094
	synthetic lubes	olefin polymer-CO-H_2 reaction	Esso Research & Engrg. Co.	2,787,644
	3a, 7a-dihydrothionaphthene sulfone	ammonia & 3,4-dihalosulfolane	Phillips Petroleum Co.	2,786,851
Measurement	surface area & pore volume	system having equilibrium gas	American Cyanamid Co.	2,788,657
Oxidation	petroleum extract	prior propane-phenol, silica gel treatment	Phillips Petroleum Co.	2,786,803
	xylene	liquid phase reaction	Union Oil Co. of Calif.	2,788,367
Polymerization	olefins	org. ester of inorg. of P acid	Esso Research & Engrg. Co.	2,786,878
Preparation	white oil	treatment of mineral oil	Esso Research & Engrg. Co.	2,788,310
Production	lube oils	fractionation, dewaxing, deresining, and hydrogenation	Universal Oil Products Co.	2,787,582

Continued on p. 146

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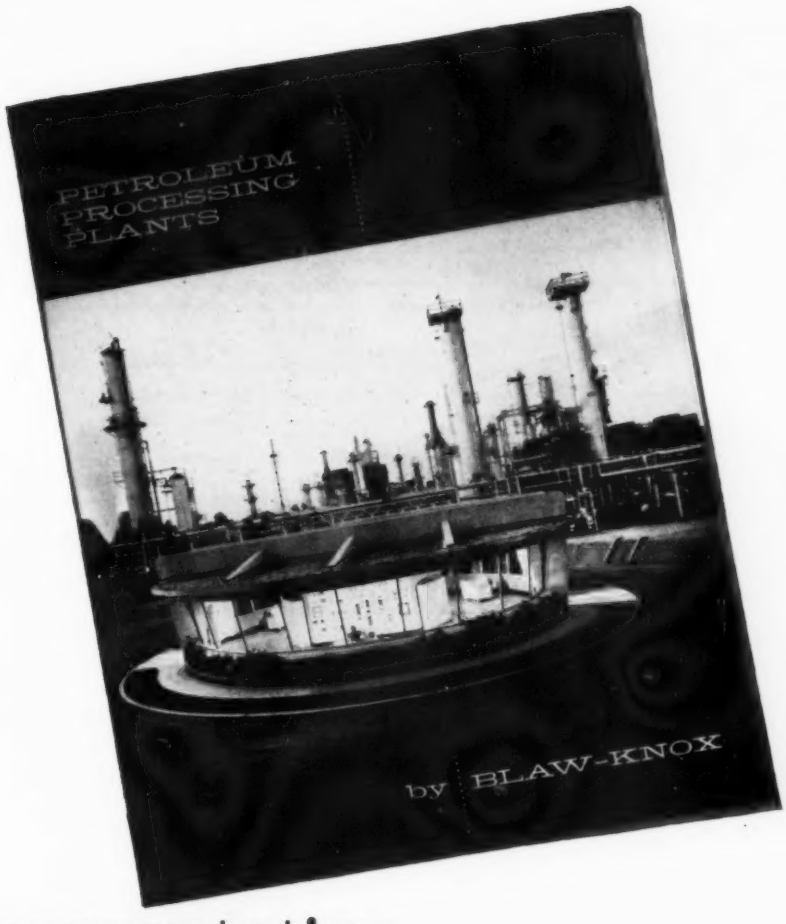

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(To obtain more data on advertised products see page 158)

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Purification	C_4-C_8 alcohols	extractive distillation	Esso Research & Engrg. Co.	2,788,313
	phthalic anhydride	distillation of water slurry	California Research Corp.	2,786,805
Pyrolysis	hydrocarbons	separation of steam & products	M. W. Kellogg Co.	2,786,802
Reaction	liquid-gas	phase change	Chemical Construction Corp.	2,787,521
Recovery	naphthenic acids	sodium salt extraction	Esso Research & Engrg. Co.	2,789,134
	platinum from alumina	mineral acid digestion	Universal Oil Products Co.	2,786,752
	platinum from catalyst	aqua regia and precipitation	Universal Oil Products Co.	2,787,540
Removal	acetylene component	volatile solvent and dist.	Koppers Co., Inc.	2,787,335
	alkali metal	acetic acid treat of viscous hydrocarbons	Phillips Petroleum Co.	2,787,647
	impurities in diolefins	cuprous ammonium acetate extraction	Polymer Corp. Ltd.	2,788,378
Separation	aliphatics & naphthenics	distillation and PCl_3 & PBr_3	Phillips Petroleum Co.	2,786,804
	cyclic & acyclic hydrocarbons	perfluorcarbons	Phillips Petroleum Co.	2,789,087
	metal sulfonate	treat of sulfonate-containing solvent	Esso Research & Engrg. Co.	2,786,868
	oxygen-nitrogen	liquef. & rectif. plant	British Oxygen Co. Ltd.	2,788,638
	oxygen-nitrogen	variable output low-temp. system	Union Carbide & Carbon Corp.	2,788,646
Sulfurization	organic compounds	sulfur dioxide	Gulf Research & Development Co.	2,786,829
Treating	hydrogels	dehydrated dry gas	Houdry Process Corp.	2,786,818
Treatment	partially oxidized hydrocarbons	resulting satisfactory color	Sun Oil Co.	2,789,123
Thermal conversion	hydrocarbons	elognated tubular wall	Lummus Oil Co.	2,789,148

Products

Asphalt emulsion	oil-in-water	emulsifying additives	Standard Oil Co. (Ohio)	2,786,775
Detergent	dialkyl sulfoxide	water-soluble salt	Union Oil Co. of Calif.	2,787,595
Detergent lube oil	mineral lube oil	detergency additive	Gulf Oil Corp.	2,789,092
Extreme pressure lube	mineral lube oil	tartaric acid & monooleate	Shell Development Co.	2,788,326

Continued on p. 148

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Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO.
Filter adhesive	hydrocarbon oil	polyethylene & wax thickener	California Research Corp.	2,789,093
Fuel Oil	350-750°F oil	oil-soluble ether	California Research Corp.	2,786,745
Lubricant	lube oil	tin-thioxanthate cmpds	Esso Research & Engrg. Co.	2,786,813-4
Mineral Oil product	mineral oil	organo-tetravalent tin cmpd.	Esso Research & Engrg. Co.	2,786,812
Stabilized product	sweetened naphtha	corrosion inhibiting adlitive	Pure Oil Co.	2,787,531

Equipment

Computation	gas calculations	analog computer	Sun Oil Co.	2,788,938
Control	fluids	slide valve structure	Esso Research & Engrg. Co.	2,787,438
	pressure	fluidized solids operations	Esso Research & Engrg. Co.	2,787,061
	temperature	chemical reaction vessels	Shell Development Co.	2,788,264
Feeding	carbon black	cyclone separator to processing mills	Phillips Petroleum Co.	2,788,267
Gasification	coal	equip. in underground coal vein	Phillips Petroleum Co.	2,786,660
Heat exchange	circulating fluids	vert. exchanger plate elements	Esso Research & Engrg. Co.	2,787,444
Measurement	fluid flow	magnetized impeller and conduit	Phillips Petroleum Co.	2,786,351
Pressure-flow control	fluids	variable control valve	Shell Development Co.	2,788,192
Proportioning	fluids	connected chamber system	Phillips Petroleum Co.	2,787,281
Purification	gases	sloping gas diffusing tray	Koppers Co., Inc.	2,788,263
Reaction	chemicals	high-temp., reactor-oven	E. Stirnemann	2,788,266
	fluid materials	dense-phase fluid solids bed	Gulf Research & Development Co.	2,786,742
Reforming	hydrocarbon gases	ammonia synthesis gas prod.	Phillips Petroleum Co.	2,788,265
Safe storage	LPG	pressure relief valve	Phillips Petroleum Co.	2,787,127
Separation	dissimilar liquids	thermal diffusion apparatus	Standard Oil Co. (Ohio)	2,789,088-9
	fluids	slanted trays & upflow in tower	Esso Research & Engrg. Co.	2,787,453
	fluids	thermal diffusion apparatus	Standard Oil Co. (Ohio)	2,788,321-2
	fluids-gases	simultaneous oil-water sep.	Black, Sivalls & Bryson, Inc.	2,786,543
	granular solids-gases	gas lift system	Houdry Process Corp.	2,786,722
	liquid-gas	spherical tank separator	Delta Tank Mfg. Co., Inc.	2,788,080
	liquid-vapor	cylindrical evaporation vessel	California Research Corp.	2,786,546
	particles-fluids	centrifugal separator	Universal Oil Products Co.	2,786,547
	suspended solids	catch vessels for fluid streams	Shell Development Co.	2,786,545

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Will the blot go on spreading? Or will a concerted, nationwide attack on the causes of slums shrink it, year by year, until it is wiped out? Today, this is a challenge to every American . . . a challenge that *must* be met.

Your community . . . your problem!

A slum reaches across blocks, across miles, to sit on your doorstep and demand a price.

You pay it in the threat of crime and juvenile delinquency to your family. You pay the price in higher personal property taxes to fight the disease and crime and poverty that are slum-bred. You pay personally when the value of your home sinks as community deterioration takes another step closer.

Your *firm* pays when the community where you do business goes downhill. Slums automatically mean lower purchasing power and less effective labor.

Good citizenship is good business

It's good citizenship and good business both for your firm to join efforts to check housing decay . . . to stop slums before they start. In fact, it's the *responsibility* of every business, as it is of every other good citizen, to support community improvement efforts.

Some slums are beyond repair. They should be torn down and a fresh start made. Others can be remodeled, made to conform to better living standards. So it is up to you to get behind every sound program which seeks to provide adequate housing for all our people.

Adding your support to the efforts of the millions already attacking the problem, your firm can help stop slums cold and put America's housing standards at a new height.

How to get into action

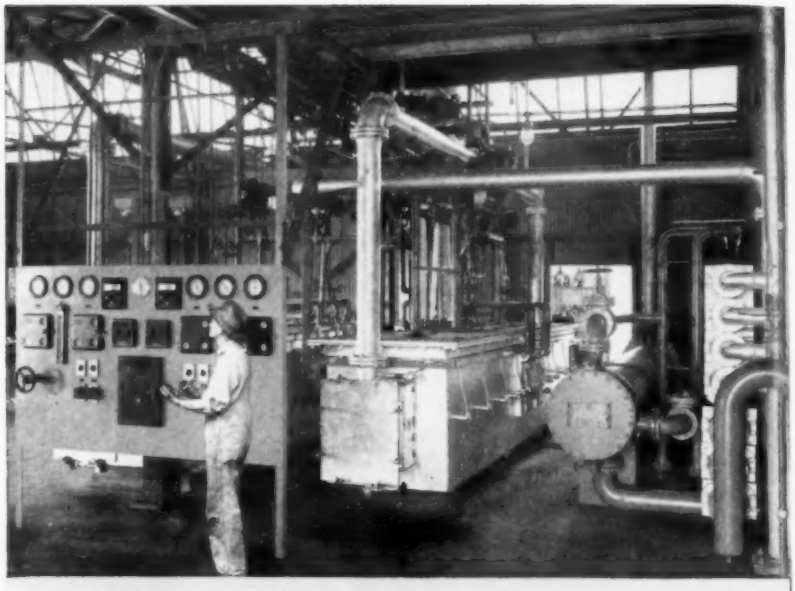
A group of Americans from every walk of life has formed a new, non-profit organization to help combat home and community deterioration – The American Council To Improve Our Neighborhoods . . . A.C.T.I.O.N.

Send for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It also lists booklets, research reports, check-lists, and other material which can help you protect the housing health of your community. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

ACTION

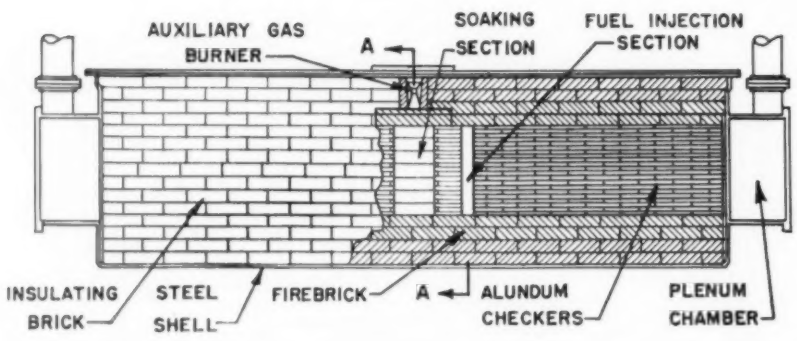
American **C**ouncil **T**o **I**mprove **O**ur **N**eighborhoods

ALUNDUM* checkers give 4 years continuous service

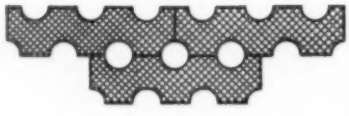


In this double regenerative furnace the Wulff Process Company of Huntington Park, Calif., produces acetylene starting with propane or other petroleum gas as the raw material. The Wulff Company reports that ALUNDUM checkers in this equipment are still going strong after continuous service, five days a week for more than four years.

Wulff Process Company says no replacement required in acetylene producing furnaces



Cross sectional diagram shows, in yellow, the location of Norton ALUNDUM checkers in the Wulff furnace. Air, preheated in the first ALUNDUM regenerator to 1800° F., is mixed with gas in the fuel injection section producing high temperatures and transferring this heat to the second regenerator. A propane-steam mixture is then passed in the opposite direction through the regenerators, heating and cracking in the second and cooling in the first. The heating and cracking cycles are both of one minute duration. ALUNDUM checkers take this extreme cyclic thermal stress and provide efficient, low cost operation.



Tubular passages for preheated flow are formed by ALUNDUM checkers. Their resistance to the erosion of hot gases is extremely important in many installations. Also, their purity is essential. Iron or other impurities could result in harmful side reactions in such gas cracking operations.

Norton refractories, engineered and prescribed for better performance in many types of equipment, provide long life, exceptional hot strength and maximum protection against the mechanical and chemical attacks of a wide variety of fuels. For further facts on these advantages write to NORTON COMPANY, Refractories Division, 265 New Bond Street, Worcester 6, Mass.

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Details on ASME petroleum conference

PANEL discussions on the American Standards Assn. piping code and the pressure method code of the ASME will highlight the refining program of the petroleum mechanical conference, Sept. 23-25. The conference is sponsored each year by the American Society of Mechanical Engineers, and the site this time is the Mayo Hotel, Tulsa, Okla.

Besides these discussions the program will include four sessions on refining and one on materials. Papers in the materials session are as follows:

"Packing and Gaskets," by R. H. Koch, Du Pont Co.

"Experience with Reformer Tubes," author to be chosen, International Nickel Co.

Following are the papers to be read at the refining sessions:

"Eight Years' Experience with Inert Gas Injection Equipment at Elk Basin," by B. O. Bates, Pan American Petroleum Corp.

"Inert Gas Safety in Operation Control," by C. H. Evans, Engineering Division, Du Pont Co.

"Scheduling Engineering Design—A Vital Force in Refining Operations," by H. T. Campbell, Humble Oil & Refining Co.

"Evaluation and Development of Technical People," by W. P. Raymond, Esso Standard Oil Co., Baton Rouge.

"Selection and Installation of Mechanical Seals for General Service," by A. L. Decker, Ethyl Corp., Baton Rouge.

"Gas Turbines," by J. K. Hubbard and T. P. Latimer, Clark Brothers, Olean, N.Y.

"Low Temperature Application of Steels," by Dr. W. S. Pellini, Naval Research Laboratory, Washington, D.C.

"Plastic Pipe in the Petroleum Industry," by George C. Anderson, National Tube Co., Pittsburgh.

Papers for refiners at ASTM annual, June 16-21

The 60th annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall in Atlantic City, N.J., from June 16 to 21.

A number of papers of interest to refining men will be presented at the meeting. In the session on high temperature properties of metals, these papers will be heard:

"Embrittlement Tendencies of Austenitic Superheater Materials at Elevated Temperatures," by J. H. Hoke and F. Eberle, Babcock & Wilcox Co.

"Constant Stress, Creep-Rupture Tests of a Killed Carbon Steel," by Pryor N. Randall, Standard Oil Co. (Ind.)

The session on radiation effects on materials will include these papers:

"Application of the Battelle Research Reactor to Radiation-Effects Studies," by J. W. Chastain, Jr., Battelle Memorial Institute.

"A Survey of the Radiation Stability of Hydrocarbon Fuels," by J. B. Carroll, R. O. Bolt, and J. A. Bert, California Research Corp.

There will also be sessions on spectrochemical analysis for trace elements, recording and testing techniques, and other topics. The Marburg lecture, on industrial water this year, will be given by Everett P. Partridge, Hall Laboratories. The Gillett Memorial Lecture will be presented by A. J. Herzig, Climax Molybdenum Co. Title of the lecture is "A Perspective of Mo-Base Alloys."

Oil Man's Calendar

Boldface items reviewed in this issue

JUNE

16-21 American Society for Testing Materials, annual, Chalfonte-Haddon Hall, Atlantic City

17-20 3rd Conference on Carbon, National Science Foundation, U. of Buffalo, Buffalo, N.Y.

17-21 Gordon Research Conference on Catalysis, AAAS, Colby Junior College, New London, N.H.

17-21 American Society for Engineering Education, annual, Cornell, Ithaca

18-19 Rocky Mountain Oil & Gas Assn., Refining Committee, annual, Northern Hotel, Billings, Mont.

19-21 Assn. for Computing Machinery, annual, U. of Houston, Houston

20-21 Western Petroleum Refiners Assn., Mid-Continent Regional technical-industrial relations meeting, Broadview Hotel, Wichita, Kan.

24-28 American Institute of Electrical Engineers, summer general, Sheraton-Mt. Royal Hotel, Montreal

26-29 American Assn. of Cost Engineers, annual, U. of New Hampshire, Durham, N.H.

JULY

8-12 Gordon Conference on Radiation Chemistry, New Hampton School, New Hampton, N.H.

15-19 Gordon Conference on Corrosion, Colby Junior College, New London

22-26 Electronic Data Processing for Business and Industry, Hotel Roosevelt, New York City

AUGUST

11-15 Heat Transfer Conference, American Society of Mechanical Engineers, Penn State College, University Park, Pa.

12-14 Society of Automotive Engineers, West Coast, Olympic Hotel, Seattle

26-28 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

26-30 American Institute of Electrical Engineers, Pacific General, Yakima, Washington

28-30 Instrument Society of America, symposium on gas chromatography, Lansing, Mich.

SEPTEMBER

8-13 American Chemical Society, national meeting, New York City

9-13 Instrument Automation Conference and Exhibit, Instrument Society of America, Cleveland Auditorium

11-13 National Petroleum Assn., annual, Traymore Hotel, Atlantic City

23-25 Petroleum Mechanical Conference, ASME, Tulsa, Okla.

23-25 American Society of Mechanical Engineers, fall meeting, Statler, Hartford, Conn.

26-27 Western Petroleum Refiners Assn., Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

27 Natural Gasoline Assn. of America, Oklahoma Regional, Skirvin Hotel, Oklahoma City

OCTOBER

7-9 Lubrication Conference, ASME and the American Society of Lubrication Engineers, Royal York Hotel, Toronto

7-11 American Institute of Electrical Engineers, fall general, Morrison Hotel, Chicago

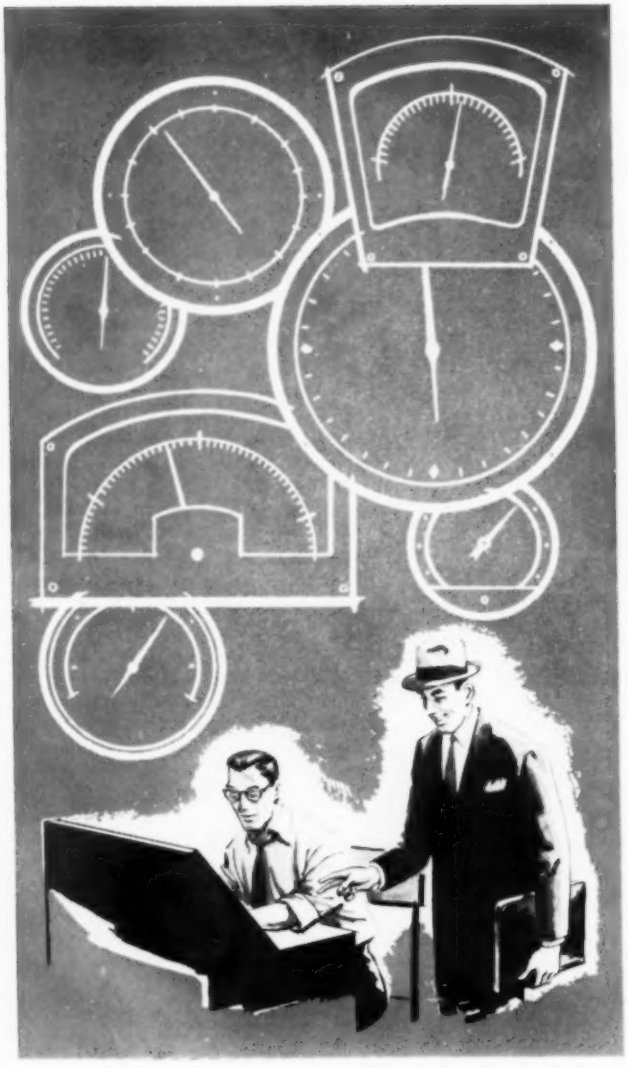
10-11 California Natural Gasoline Assn., annual, Huntington-Sheraton Hotel, Pasadena

22-24 Western Regional Conference, National Assn. of Corrosion Engineers, San Diego

NOVEMBER

4-8 National Metal Congress & Exposition and 2nd World Metallurgical Congress, sponsored by American Society for Metals, AIMME and others, International Amphitheater, Chicago

11-14 American Petroleum Institute, annual, Conrad Hilton Hotel, Chicago



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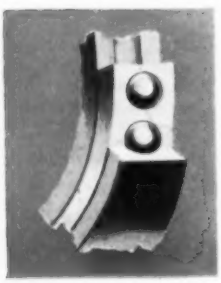

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The Cyanamid AEROLUBE® series of lube oil additives are formulated to meet the varying requirements of different base stocks. AEROLUBE 93-C, a concentrated inhibitor with superior anti-wear characteristics, rounds out our line of general purpose inhibitor-detergents.

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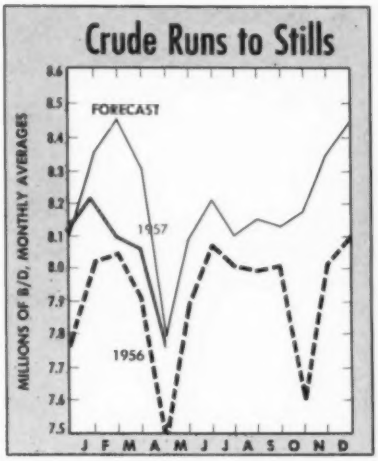
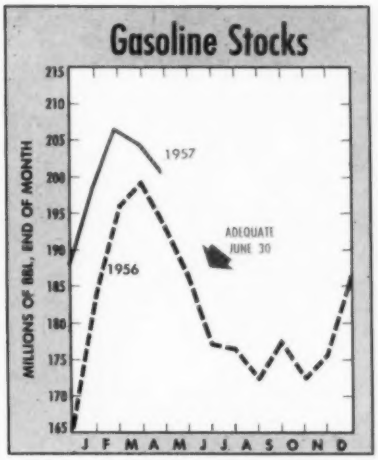
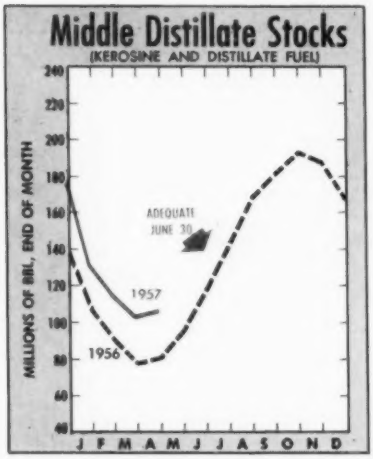





Middle Distillate Stocks
(KEROSINE AND DISTILLATE FUEL)
MILLIONS OF BBL, END OF MONTH
ADEQUATE JUNE 30
1957
1956
J F M A M J J A S O N D

Supply outruns demand

OUTLOOK: For domestic gasoline demand in the third quarter to run about 6% higher than last year, after being held back by cold wet spring.

U. S. REFINERS start the second half of 1957 with the prospects of a greater growth in domestic demand than during the first six months. Total domestic shipments are now forecast at 9,225,000 b/d avg. over the coming six months, 7.2% larger than in the same period in 1956. The large drop in exports, with the ending of emergency shipments to Western Europe, compared with a year ago will bring total product demand to 9,558,000 b/d avg. for the period, about 4.7% larger than in 1956.

On the supply side of the picture, all present indications are that runs to stills will remain too high for a balance in supply and demand by fall. Total U.S. crude runs, estimated at 8,120,000 b/d avg. over the first six months, are now forecast at 8,210,000 bbl during the third quarter, and 8,315,000 bbl for the fourth quarter, an average for the year of 8,192,000 b/d.

Contributing also to the heaviness of product inventories at mid-year was the warmer-than-normal heating season, which held down actual consumption of heating oils, and the cold wet spring had its effect on gasoline demand. Total U.S. stocks of gasoline, kerosine, distillate fuel oil and residual fuels March 31, 336,400,000 bbl, were 8% higher than on the same date in 1956. By May 10 these stocks had built up further to a total of 340,300,000 bbl. Gasoline inventories had been drawn on to the extent of nearly 6,000,000 bbl, but kerosine, distillate fuel oil and residual fuel stocks had been built up by nearly 10,000,000 bbl.

With crude runs continuing at their high current levels, it will be difficult for gasoline stocks to drop to the 180,500,000 bbl believed adequate for June 30, and for distillate fuel oil stocks not to exceed the estimated adequate 102,100,000 bbl. level.

APRIL KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbl at end of month)

	Apr. 1957	Mar. 1957	Apr. 1956
CRUDE OIL			
U. S. Production	7.527	7.782	7.146
Imports	.891	.819	.815
U. S. Stocks	261.050	252.311	277.121
Runs to Stills	7.746	8.050	7.487
GASOLINE			
Refinery Output	3.741	3.709	3.557
Refinery Demand	4.002	3.838	3.859
Primary Stocks	199.142	203.361	193.299
MIDDLE DISTILLATES			
Refinery Output	2.047	2.191	2.012
Refinery Demand	1.993	2.585	1.912
Primary Stocks	97.995	95.739	81.798
RESIDUALS			
Refinery Output	1.165	1.226	1.130
Imports & Other	.538	.621	.484
Total Supply	1.703	1.847	1.614
Refinery Demand	1.703	1.835	1.622
Primary Stocks	37.240	37.240	32.740

PRODUCT AND CRUDE PRICES

(Products—¢ gal, weighted average prices in principal refinery markets
Crudes—$/bbl, principal fields
Source—Platt's Oilgram Price Service)

	Apr. 1957	Mar. 1957	Apr. 1956
Gasoline (regular)	12.71	12.68	11.76
Distillate Fuel Oil	10.38	10.40	9.40
Kerosine	11.90	11.92	10.95
Residuals	6.42	6.48	5.19
Above 4 Products	10.43	10.44	9.40
Lube Oils	24.17	24.17	22.40
Crude	3.18	3.18	2.84

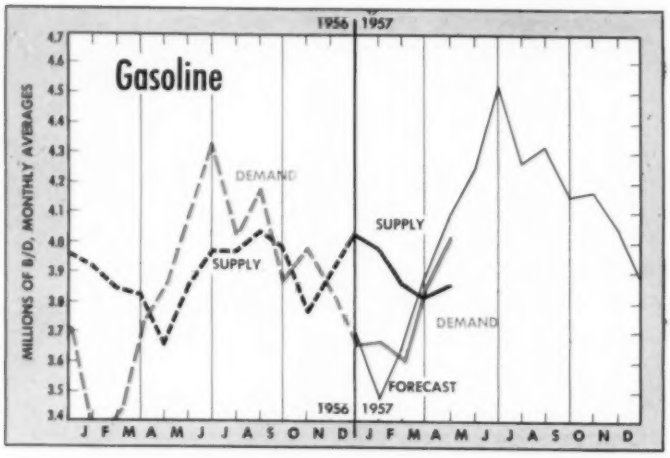
REFINERY YIELDS

% on Crude Runs to Stills

	Apr. 1957	Mar. 1957	Apr. 1956
Gasoline	44.1	42.0	43.0
Kerosine	3.6	4.1	4.0
Distillate	22.8	23.1	22.9
Residuals	15.0	15.2	15.1

SOURCE OF DATA (except prices): Mar. and Apr., API weekly reports; earlier months Bureau of Mines

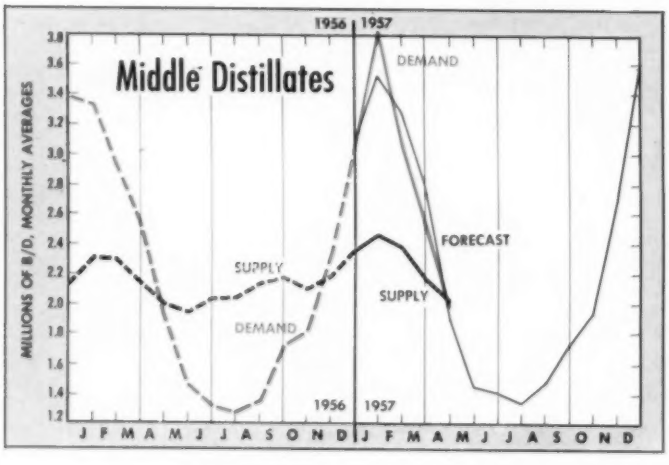
Early up trend in gasoline supply indicated


Gasoline
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
SUPPLY
SUPPLY
DEMAND
FORECAST
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MOTOR FUEL

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
Apr. '57	3.413	.448	3.861
Apr. '56	3.221	.425	3.646
Change	+ .192	+ .023	+ .215
% Change	+ 6.0	+ 5.4	+ 5.9
DEMAND (including Exports) (Millions of b/d)			
Apr. '57			4.002
Apr. '56			3.859
Change			+ .143
% Change			+ 3.7
TOTAL SUPPLY (Millions of bbl)			
4 Mos. '57	411.696	54.561	466.257
4 Mos. '56	409.498	52.053	461.551
Change	+ 2.198	+ 2.508	+ 4.706
% Change	+ 0.5	+ 4.8	+ 1.0
TOTAL DEMAND (including Exports) (millions of bbl)			
4 Mos. '57			451.167
4 Mos. '56			434.818
Change			+ 16.349
% Change			+ 3.8

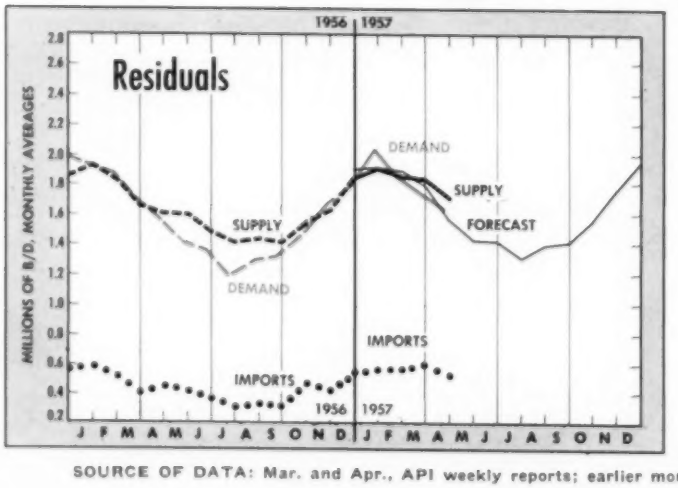
Sharp seasonal drop in distillates demand


Middle Distillates
1956 | 1957
MILLIONS OF B/D, MONTHLY AVERAGES
DEMAND
FORECAST
SUPPLY
SUPPLY
DEMAND
1956 1957
J F M A M J J A S O N D J F M A M J J A S O N D

MIDDLE DISTILLATES

	Kerosine	Dist. Fuel Oil	Total
PRODUCTION (Millions of b/d)			
Apr. '57	.282	1.765	2.047
Apr. '56	.299	1.713	2.012
Change	— .017	+ .052	+ .035
% Change	— 5.7	+ 3.0	+ 1.7
DEMAND (including Exports) (Millions of b/d)			
Apr. '57	.259	1.734	1.993
Apr. '56	.272	1.640	1.912
Change	— .013	+ .094	+ .081
% Change	— 4.8	+ 5.7	+ 4.2
TOTAL PRODUCTION (Millions of bbl)			
4 Mos. '57	39.881	233.340	273.221
4 Mos. '56	42.673	222.671	265.344
Change	— 2.792	+ 10.669	+ 7.877
% Change	— 6.5	+ 4.8	+ 3.0
TOTAL DEMAND (including Exports) (Millions of bbl)			
4 Mos. '57	51.500	293.241	344.741
4 Mos. '56	51.984	273.042	325.026
Change	— .484	+ 20.199	+ 19.715
% Change	— 0.9	+ 7.4	+ 6.1

Residual fuel supply and demand at same level



RESIDUAL FUELS

	Refinery Output	Imports & Other	Total
SUPPLY (Millions of b/d)			
Apr. '57	1.165	.539	1.703
Apr. '56	1.130	.484	1.614
Change	+ 0.35	+ .054	+ .089
% Change	+ 3.1	+ 11.2	+ 5.5
DEMAND (Millions of b/d) (including Exports)			
Apr. '57			1.703
Apr. '56			1.622
Change			+ .081
% Change			+ 5.0
TOTAL SUPPLY (Millions of bbl)			
4 Mos. '57	149.492	70.208	219.700
4 Mos. '56	150.475	63.547	214.022
Change	— .983	+ 6.661	+ 5.678
% Change	— 0.7	+ 10.5	+ 2.7
TOTAL DEMAND (Including Exports) (Millions of bbl)			
4 Mos. '57			227.618
4 Mos. '56			220.456
Change			+ 7.162
% Change			+ 3.2

SOURCE OF DATA: Mar. and Apr., API weekly reports; earlier months Bureau of Mines (1956 figures for 366 days)

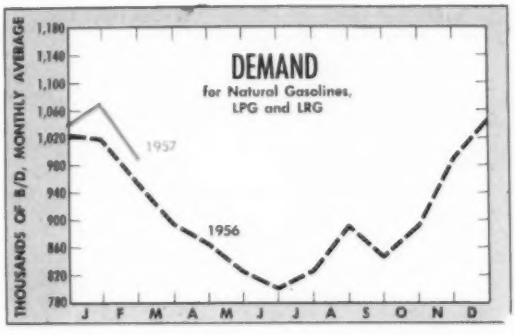
RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U. S. REFINERY DISTRICTS

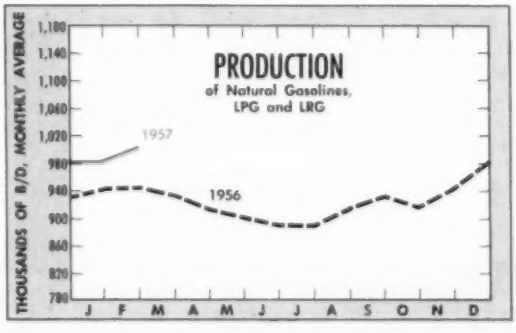
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) May 10 1957	May 11 1956	Change	% Change	GASOLINE STOCKS (Millions of bbl, on date shown) May 10 1957	May 11 1956	Change	% Change	RESIDUAL STOCKS (Millions of bbl on date shown) May 10 1957	May 11 1956	Change	% Change
East Coast	1.219	1.109	+ .110	+ 9.9	43.451	39.579	+ 3.872	+ 9.7	9.672	7.591	+ 2.081	+27.4
Gulf Coast	2.530	2.691	— .161	— 6.0	37.134	36.913	+ .221	+ 0.6	5.962	6.805	— .843	—12.4
Total Coastal	3.749	3.800	— .051	— 1.3	80.585	76.492	+ 4.093	+ 5.4	15.634	14.396	+ 1.238	+ 8.6
Appalachian	.203	.208	— .005	— 2.4	7.837	7.566	+ .271	+ 3.6	.842	.513	+ .329	+64.1
Ind.-Ill.-Ky.	1.473	1.368	+ .105	+ 7.7	39.331	39.539	— .208	— 0.5	5.234	3.840	+ 1.394	+36.3
Okla.-Kans.-Mo.	.724	.720	+ .004	+ 0.6	21.838	19.922	+ 1.916	+ 9.6	1.099	1.061	+ .038	+ 3.6
Other Inland	.660	.633	+ .027	+ 4.3	20.360	19.130	+ 1.230	+ 6.4	2.986	2.236	+ .750	+33.5
Total Inland	3.060	2.929	+ .131	+ 4.5	89.366	86.157	+ 3.209	+ 3.7	10.161	7.650	+ 2.511	+32.8
Total East of Calif.	6.809	6.729	+ .080	+ 1.2	169.951	162.649	+ 7.302	+ 4.5	25.795	22.046	+ 3.749	+17.0
Calif.	1.241	1.182	+ .059	+ 5.0	27.451	25.059	+ 2.392	+ 9.5	12.950	11.073	+ 1.877	+17.0
Total U. S.	8.050	7.911	+ .139	+ 1.8	197.402	187.708	+ 9.694	+ 5.2	38.745	33.119	+ 5.626	+17.0

District	DISTILLATE FUEL OIL STOCKS (Millions of bbl on date shown) May 10 1957	May 11 1956	Change	% Change	KEROSINE STOCKS (Millions of bbl, on date shown) May 10 1957	May 11 1956	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbl on date shown) May 10 1957	May 11 1956	Change	% Change
East Coast	26.118	17.739	+ 8.379	+47.2	9.202	7.298	+ 1.904	+26.1	35.320	25.037	+10.283	+41.1
Gulf Coast	13.873	14.511	— .639	— 4.4	4.880	5.488	— .608	—11.1	18.753	19.999	— 1.246	— 6.2
Total Coastal	39.991	32.250	+ 7.741	+24.0	14.082	12.786	+ 1.296	+10.1	54.073	45.036	+ 9.037	+20.1
Appalachian	2.447	1.869	+ .578	+30.9	.863	.905	— .042	— 4.6	3.310	2.774	+ .536	+19.3
Ind.-Ill.-Ky.	14.589	10.391	+ 4.198	+40.4	4.049	3.430	+ .619	+18.0	18.638	13.821	+ 4.817	+34.9
Okla.-Kans.-Mo.	9.497	7.080	+ 2.417	+34.1	1.374	.904	+ .470	+52.0	10.871	7.984	+ 2.887	+36.2
Other Inland	5.851	4.927	+ .924	+18.8	1.232	.917	+ .315	+34.4	7.083	5.844	+ 1.239	+21.2
Total Inland	32.384	24.267	+ 8.117	+33.4	7.518	6.156	+ 1.362	+22.1	39.902	30.423	+ 9.479	+31.2
Total East of Calif.	72.375	56.517	+15.858	+28.1	21.600	18.942	+ 2.659	+14.0	93.975	75.459	+18.516	+24.5
Calif.	9.885	8.428	+ 1.457	+17.3	.307	.390	— .083	—21.3	10.192	8.818	+ 1.374	+15.6
Total U. S.	82.260	64.945	+17.315	+26.7	21.907	19.332	+ 2.575	+13.3	104.167	84.277	+19.890	+23.6

Natural gas and refinery gas liquids





SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	Feb. 1957	Jan. 1957	Feb. 1956
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	463	459	435
Natural Gasoline and Isopentane	293	274	278
Condensate	20	23	29
Finished Gasoline, Naphtha and other	70	70	64
Total Natural Gasoline and Cycling Plant Production	846	826	806
Liquefied Refinery Gases	154	155	143
Total Marketable Gas Liquids	1,000	981	949
Lease Condensate	148	147	129
Total Natural Gas Liquids	1,148	1,128	1,078
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	615	721	589
Natural Gasoline, Isopentane and Other	379	355	370
Total Marketable Gas Liquids	994	1,076	959

CUMULATIVE PRODUCTION (1000 bbl)	Feb. 1957	Feb. 1956
LPG and ERG	36,292	34,672
Natural Gasoline, Isopentane and Other	22,101	22,236
Total Marketable Gas Liquids	58,393	56,908
CUMULATIVE DEMAND (1000 bbl)		
LPG and LRG	39,578	37,668
Natural Gasoline, Isopentane and Other	21,646	21,774
Total Marketable Gas Liquids	61,224	59,442

STOCKS (1000 bbl, end of month)	Feb. 1957	Jan. 1957	Feb. 1956
LPG and LRG	11,462	11,415	4,742
Natural Gasoline, Isopentane and Other	5,425	5,337	4,946
Total Stocks	16,887	16,752	9,688

INFORMATION OFFERED

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

Annual report, Standard Oil Company (New Jersey). See adv't. p. 175.

Blending equipment, data; Proportioneers, Inc., B-I-F Industries, Inc. See adv't. Cover 2.

Boilers, steam generators, bulletin B-55-4; Foster Wheeler Corp. See adv't. p. 21.

Catalyst, platinum, brochure; Baker & Co. See adv't. p. 25.

Catalysts, many types and shapes, booklet; Harshaw Chemical Co. See adv't. p. 130.

Chromatographs, gas and vapor phase, bulletins; Burrell Corp. See adv't. p. 146.

Cleaning compounds, chemical, booklet 7629; Oakite Products, Inc. See adv't. p. 125.

Connectors and panels, for thermocouples, bulletin 23-I; Thermo Electric Co., Inc. See adv't. p. 144.

Controller, electronic, recording and indication, bulletin RC100; Manning, Maxwell & Moore, Inc. See adv't. p. 171.

Corrosion inhibitor, for products, samples and information; Universal Oil Products Co. See adv't. p. 36.

Engineering, process plants, booklet; Blaw-Knox Co. See adv't. p. 145.

Expansion joints, self equalizing, catalog 56; Zallea Brothers. See adv't. p. 55.

Filters, for petroleum liquids, technical literature; Commercial Filters Corp. See adv't. p. 23.

Floating roofs, bulletin TS; Hammond Iron Works. See adv't. p. 50.

Flowmeters, bulletin PP-5; Potter Aeronautical Corp. See adv't. p. 43.

Fluid controls, traps, brochures; Clark Mfg. Co. See adv't. p. 174.

Gas generators, dryers, for purging, technical information; C. M. Kemp Mfg. Co. See adv't. p. 42.

Gaskets, couplings, plastic, catalogs AD-137 & AD 154; U. S. Gasket Co. See adv't. p. 141.

Gratings and treads, welded, bulletin PP-67; Rockwell Spring & Axle Co. See adv't. p. 176.

Insulation, cement, hydraulic setting, information; Baldwin-Hill Co. See adv't. p. 53.

Insulation, pipe, molded glass fiber, information; Gustin-Bacon Mfg. Co. See adv't. pp. 18-19.

Mixers, side and top entering, 8 catalogs and data sheets; Mixing Equipment Co., Inc. See adv't. p. 64.

Mixers, portable, bulletin 520-B; Eastern Industries, Inc. See adv't. p. 184.

Motor starters, high voltage, bulletin 8131-L; Electric Controller & Mfg. Co., Div. of Square D Co. See adv't. p. 31.

Oxygen analyzers, data file 21J-67; A. O. Beckman, Inc. See adv't. p. 186.

Packing removal tool, hooks, bulletin DHPP; Durametallic Corp. See adv't. p. 184.

Piping assemblies, cold extruded, bulletin CE-0.001; Fluor Products Co. See adv't. cover 4.

Piping and equipment, aluminum, booklet; Aluminum Co. of America. See adv't. pp. 40-41.

Pumps, stuffingboxless, for light hydrocarbons, bulletin 107; Bingham Pump Co. See adv't. p. 17.

Pumps, proportioning, booklet; Hills-McCanna Co. See adv't. p. 172.

Pumps, bulletin; Peerless Pump Div. See adv't. p. 38.

Recorder, water vapor, continuous, for air or gas streams, bulletin; Mine Safety Appliances Co. See adv't. p. 48.

Rotameters, bulletin 110b; Brooks Rotameter Co. See adv't. p. 166.

Seals, shaft, packing; bulletin S-205-2; Crane Packing Co. See adv't. p. 180.

Sorptive minerals, for processing, data; Minerals & Chemicals Corp. See adv't. p. 20.

Strainers, line, bulletin F-36; Jordan Corp. See adv't. p. 183.

Steam traps, bulletin 10-55; W. H. Nicholson & Co. See adv't. p. 63.

Steam traps, catalog J; Armstrong Machine Works. See adv't. p. 147.

Steam traps, information; V. D. Anderson Co. See adv't. p. 165.

Tube maintenance tools, cleaners, expanders, bulletin 60; Airetool Mfg. Co. See adv't. p. 182.

Tubes, condenser, finned, catalog; Wolvering Tube. See adv't. pp. 113-114.

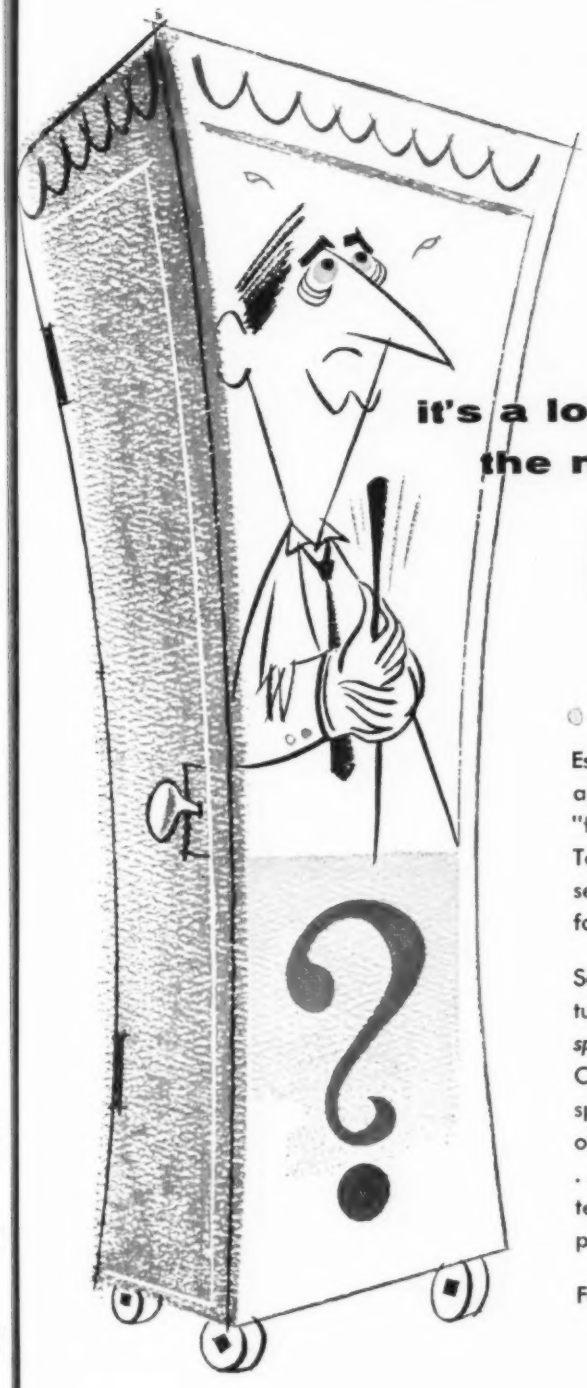
Tubes, heat exchanger, information; Republic Steel Corp. See adv't. pp. 56-57.

Valves, fittings and flanges, drop forged, catalog F-9; Henry Vogt Machine Co. See adv't. p. 173.

Valves, bellows relief, bulletin 300-JB; Crosbe Valve & Gage Co. See adv't. p. 126.

Valves, gate, booklet; Crane Co. See adv't. p. 116.

Welding electrodes, alloys, folder; International Nickel Co., Inc. See adv't. p. 26.



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Petroleum Processing

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PDS 16,	**Chemico Nitric Acid**	Reprint **R41**
PDS 17,	**H_2SO_4 Alkylation**	Reprint **R44**
PDS 18,	**Process Reference List—1954**	Reprint **R48**
PDS 19,	**Powerforming**	Reprint **R51**
EDS 13,	**Plastics Glossary—A-L**	Reprint **R38**
EDS 14,	**Plastics Glossary—M-Z**	Reprint **R40**
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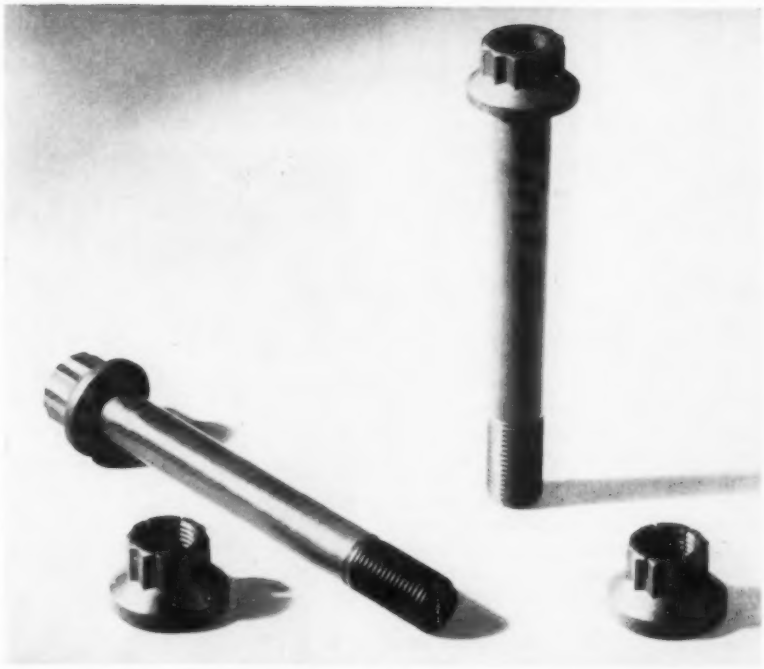
EDS 17,	**Instrument Terminology—G-P**	Reprint **R49**
EDS 18,	**Instrument Terminology—R-Z**	Reprint **R52**



High strength at high temperature

These new steel superbolts are as strong at 900°F as most high strength fasteners are at room temperatures. The Hi Tm 9 fasteners pictured above retain a minimum tensile strength of 170,000 psi at 900°F. Development work on this new bolt has also indicated that similar high strength bolts may soon be available in the 1200°F range too.

The initial fasteners in this new series are for airframes but other applications are possible in processing equipment where both high temperatures and pressure conditions exist. The fasteners are made from VascoJet 1000, a 5% chromium hot work die steel produced by Vanadium-Alloys Steel Co. For years these steels have been used for tool and die material in hot forging and extrusion presses.

Several unusual features beside strength characterize these new fasteners. The thread has a larger-than-normal radius in the root to reduce stress concentrations at the weakest point of the thread. A diffused nickel-cadmium plating provides good corrosion and oxidation resistance up to 1000°F. A special 12-point external wrenching locknut is available for use with the high strength bolt. **Standard Pressed Steel Co.,** Jenkintown, Pa.

Circle No. **1** *on Reply Card*

New plastic

. . . **resists corrosion** by hydrofluoric acid and other fluorides. It is a graphite filled epoxy resin, labeled Haveg 093, and will withstand all concentration of HF at temperatures up to 240°F in continuous operation.

Already, pipe, pump parts, valves and towers and tanks with diameters up to 10 ft have been fabricated from this new material. Fluorine salts and chemical reactions of HF with organics or inorganics can also be handled by this equipment. **Haveg Industries, Inc.** 900 Greenbank Road, Wilmington 8, Del.

Circle No. **2** *on Reply Card*

Polyethylene pipe

. . . **will handle hydrocarbon liquids,** as well as solvents and many chemicals. This high molecular weight polyethylene also is free from stress cracking.

The pipe is made from a new polyethylene resin having physical properties different from other polyethylenes. It has an unusually high melt viscosity and requires special techniques for manufacture of pipe. The resulting plastic pipe has high bursting strength and is suitable for transmission of solvents and hydrocarbons, a use denied to conventional polyethylene pipe. The pipe compound is made by Allied Chemical & Dye Corp. and the pipe by **Orangeburg Manufacturing Co.,** Inc, Orangeburg, N.Y.

Circle No. **3** *on Reply Card*

Glass diaphragm

. . . **withstands extreme temperatures** from −80° to +500°F. The seal combines a glass fabric with silicone rubber to produce a material for wide operating conditions.

Although still in the pilot stage, this diaphragm seal has already withstood 250,000 cycles at 500°F and 50 psi —for one with cylinder bore dimension of 2 in., a ½-in. height, and a 5/16-in. stroke. **Bellofram Corp.,** Burlington, Mass.

Circle No. **4** *on Reply Card*

Inert coating

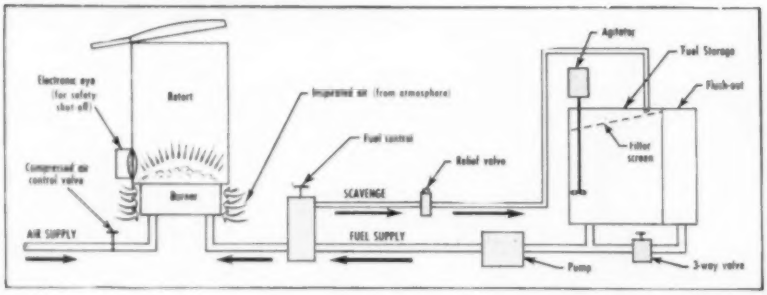
. . . **is based on Du Pont's Hypalon,** a chloronated polyethylene which is extremely resistant to ozone attack, corrosive chemicals, and weather.

Maintz is the name of this coating which has resisted ultra violet light, bacteria, flexing tests and impact and abrasion service. It is recommended for continuous service in the temperature range of −50 to 120°C.

The solvents for this coating are aromatic hydrocarbons such as xylene, benzene and toluene. Other chlorinated hydrocarbons such as carbon tetrachloride and perchloroethylene are also solvents and Maintz is not recommended for these applications. **West Chester Chemical Co.,** Box 39, West Chester, Pa.

Circle No. **5** *on Reply Card*

(Continued on p. 162)



Smoke-free incinerator

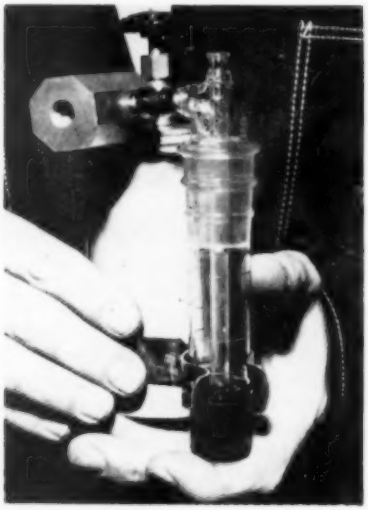
Burns any liquid combustible

The Model SF-1 incinerator is specifically designed to handle liquid sludges, oils, solvents and any other wastes that can be rendered to a liquid or slurry form. It is adaptable to any viscosity range between air-setting waxy compounds and gasoline.

Full combustion occurs at temperatures in excess of 3000°F, with no ash or smoke in the retort chamber or effluvia. Up-firing in the refractory lined, heavy gage steel retort provides explosion relief through the top. Once started, the operation of the unit is continuous and automatic.

The complete installation includes the retort, two tanks, together with suitable pumping circuit, pipe, valves and electrical controls. The incinerator is rated at 1,900,000 Btu/hr. Compressed air is used both for atomization of the fuel and for combustion. **Prenco Products, Inc.,** 507 E. Ten Mile Road. Hazel Park, Mich.

Circle No. **6** *on Reply Card*



Air sampler

. . . **has no moving parts** but is powered by a blast from a can of Freon. Weighing less than two pounds and costing a fraction of other equipment for the same purpose, this new device can be used under actual operating conditions and in cramped spaces. There is no possibility of explosion.

Principal part of the air sampling unit is an aspirator through which the propellent is ejected at high speed. Different size orifices can be inserted to control the operating pressure and the sampling rate. Typical chemical pollutants that can be determined include acid fumes, nitrogen oxides, sulfur dioxide, phosgene and hydrogen sulfide. It can also be used for dust sampling by employing a filter attachment. Developed by Du Pont industrial hygienists, the jet air sampler is available from **Union Industrial Equipment Corp.,** 175 Main St., White Plains, N.Y.

Circle No. **7** *on Reply Card*

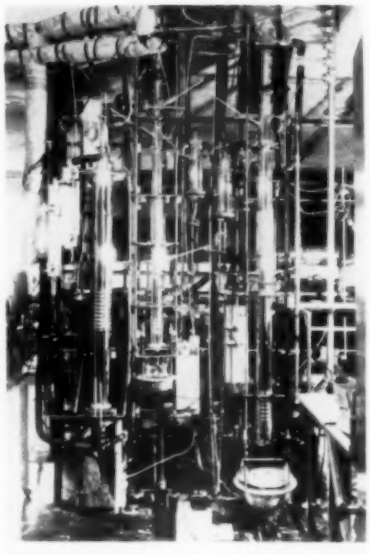
Nonflammable solvents

. . . **remove oil, grease and dirt** but can be used with conventional ventilating equipment.

Labelled "Freon" solvents, these selective solvents will be marketed in three types. Freon MF has a boiling point of 75°F, Freon BF boils at 199°F, and Freon TF has an intermediate boiling point of 118°F. This range of boiling points makes the nonflammable solvent adaptable to many types of cleaning equipment.

In addition to being non-toxic and nonflammable, these solvents have another advantage. In cleaning electrical motors or equipment, the solvent will not attack the insulation. Three years of test indicate that any of the commonly used wiring insulation materials will not soften, craze or dissolve in the new solvents. **E. I. du Pont de Nemours & Co., Inc.,** Wilmington 99, Del.

Circle No. **8** *on Reply Card*



Pilot unit

. . . **successfully extracts** petroleum fractions with SO_2 as a selective solvent. This continuous operation is for the production of high purity aromatics for petroleum blending stocks.

This unit is designed to avoid the inherent problems of batch operations but also remains extremely versatile. With minor adjustments it will perform the following operations:

1—All types of SO_2 extractions except those requiring pressures above atmospheric. These include straight extraction and modified extraction with wash oil.

2—Any extraction using straight extraction, backwash, extract reflux, or duo-solvents where operating conditions do not require pressure and where solvent recovery by fractionation is possible.

3—The fractionators may be used singly or dually in either batch or continuous precision fractionations. Compounds having atmospheric boiling points as low as —20°F may be fractionated and condensed. With minor adjustments, vacuum fractionations can be made.

This continuous pilot unit was produced by **Badger Manufacturing Co.,** Cambridge, Mass.

Circle No. **9** *on Reply Card*

(Continued on p. 164)

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Glossary of Refinery Processes and **Who's Who in Refinery Service Firms;** 168 processes, completely indexed, with 74 schematic flow charts, and over 1000 literature references, plus a coded cross-reference to the service firm directory. 56 pages. May, 1956 . . . Reprint **R47** . . . $1.00

Map of U.S. and Canadian Refineries—with code numbers keyed to the Glossary described above. Map measures 23x29 in. . . . Reprint **R45** . . . $0.25

Gaskets—How to Choose and Use Today's Gaskets in Today's Equipment, a special 16-page report by Ron Cannon: what a gasket is, how it works, types of gasketed joints, factors in design, selecting materials, how to get the most out of your gaskets. . . . Reprint **R43** . . . $0.50

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How Computers Can Help You—valuable training and information booklet. 12 pages. June, 1956 . . . Reprint **R23** . . . $0.25

Evaporation Losses—and Their Control in Storage, by Willis A. Bussard: what evaporation is, storage conditions that affect it, equipment and other methods to reduce losses, estimating losses, selecting the right tank. 24 pages. July, 1956 . . . Reprint **R20** . . . $0.75

Optimum Bubble-Cap Tray Design, by William L. Bolles; presents new concepts and easy-to-use working charts for the process design of bubble-cap trays. 51 pages. February-May, 1956 . . . Reprint **R15** . . . $1.50

Chemical Treatment of Petroleum Products, four-article symposium on the chemical treatment of petroleum streams from crude through gasolines to convert and/or remove impurities. 24 pages. April, 1956 . . . Reprint **R12** . . . $0.75

Heat Exchangers—and Their Use in Processing Petroleum, by Daniel A. Donohue: what they are, how they're made, their design, use, installation, operation, maintenance and cost. 32 pages. March, 1956 . . . Reprint **R8** . . . $1.00

Catalytic Reforming—and Aromatics Recovery in the Refinery, by Virgil B. Guthrie and Robert L. Davidson; what it is and what it does, who is using it, processes for reforming and aromatics recovery. 48 pages. August, 1955 . . . Reprint **R3** . . . $0.75

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Vaporization Equilibrium Constant and Activity Coefficient Charts, by K. A. Smith and R. B. Smith: for use in described conditions ranging up to the critical point of the system. 48 pages. December, 1949 . . . Reprint **R1** . . . $1.50

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Process Data Sheets are process descriptions with flow diagrams, process conditions, economics, etc., 3-page fold-out sheets—$0.20 each, or any PSD or EDS sheets for $1.00

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PDS 2, **Butadiene • Butenes** **R5**
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PDS 4, **Ethylene—Kellogg** **R9**
PDS 5, **Fluid Coking** **R10**
PDS 6, **Chemico Urea** **R16**
PDS 7, **Ethylene—Stone & Webster** **R18**
PDS 8, **TCP—Socony Mobil** **R21**
PDS 9, **Process Reference—1947** **R24**
PDS 10, **Ammonia—Kellogg** **R26**
PDS 11, **Pentafining** **R28**
PDS 12, **Process Reference—1955** **R32**
PDS 13, **Thermofor Catalytic Reforming** **R34**
PDS 14, **Process References—1956** **R37**
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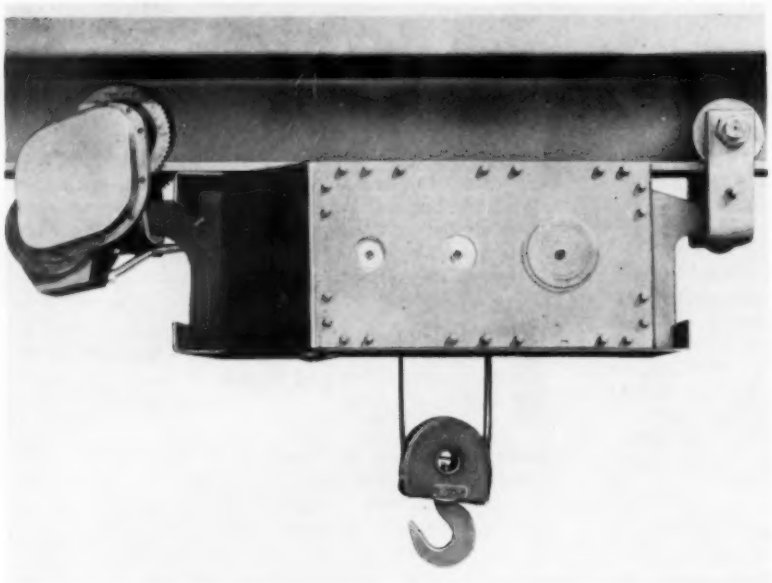
EDS 5, **Tank Capacities—I** **R17**
EDS 6, **Heat—and Its Transfer** **R19**
EDS 7, **Vapor Pressure** **R22**
EDS 8, **Distillation Fundamentals** **R25**
EDS 9, **Heat Fuel Comparison** **R27**
EDS 10, **Tank Capacities—II** **R29**
EDS 11, **Measuring Viscosity** **R33**
EDS 12, **Metals Glossary** **R35**
EDS 13, **Plastics Glossary—A-L** **R38**
EDS 14, **Plastics Glossary—M-Z** **R40**
EDS 15, **Combustible Vapors** **R42**
EDS 16, **Instrument Terminology —A-F** **R45**
EDS 17, **Instrument Terminology —G-P** **R49**
EDS 18, **Instrument Terminology —Q-Z** **R52**



Heavy duty hoist

Positions to 0.008 of an inch

Featuring low headroom and extreme positioning accuracy, this new line of electric hoists will handle from 3 to 150-ton loads. Low headroom is achieved by a flat-lying "U" shape arrangement of the motor, gear box and drum. The load block retracts between the motor and the drum, which are mounted parallel on the same side of the gear box. For a trolley-mounted hoist of 3-7½ ton capacity, the distance between rail and load-carrying eye of hook measures only 21 in.

The positioning accuracy is achieved through an instant torque motor and two braking systems. Regenerative braking regulates load travel to controllable speeds, and over-size electromechanical brakes stop capacity loads instantly. Either brake system will handle up to 150% of rated capacity. **R. G. LeTourneau, Inc.,** Longview, Texas.

Circle No. **10** *on Reply Card*

Microbalance

. . . **has accuracy of 0.05%** of full scale on all ranges. Precision is 0.02%. The Cahn Electrobalance is based on a novel application of Ampere's Law, in which a sample weight is balanced by torque applied by an electric current in a magnetic field. Because the balance beam is always returned to the same position, torque is exactly proportional to current.

With the sample weight read directly on a multiturn dial, extreme speed and easy operation are possible. Complete weighings may average less than a minute a piece. The ranges weighed are: 0 to 5 mg, with 1 microgram sensitivity; 0-10 mg at 2 microgram sensitivity; 0-20 mg at 5 microgram sensitivity; and 0-50 mg at 8 microgram sensitivity.

The instrument is portable, weighs only 12 lb, and is completely self-contained. No external power or utilities are required. The entire weighing compartment can be removed from the instrument and located remotely, with complete control through four wires. **Cahn Instrument Co.,** Downey, Calif.

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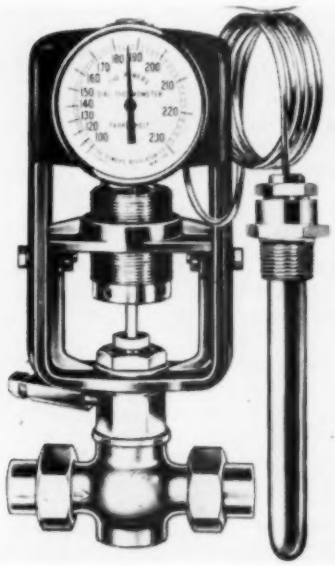

Temperature indicator

. . . **also regulates** without an external power source. A thermal bulb, filled with a volatile fluid, is connected to a diaphragm bellows. Any temperature change of the volatile fluid varies the pressure that is transmitted to the bellows. The action of the bellows, in turn, can be used to operate another steam control valve.

The No. 11 regulator has a front-mounted dial thermometer to provide continuous readings of the process temperature. Control can be exercised as low as 60°F and as high as 260°F. **Powers Regulator Co.,** 3434 Oakton St., Skokie, Ill.

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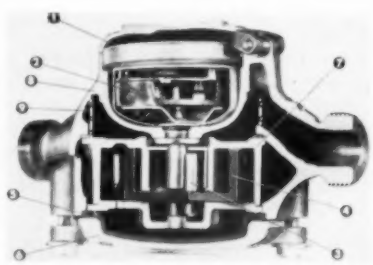


Magnetic water meter

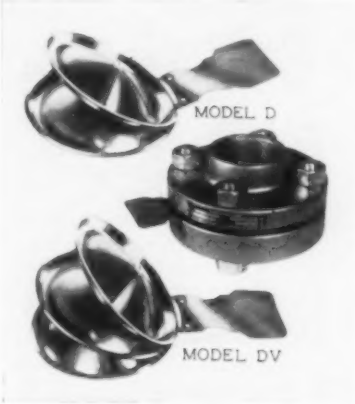
. . . **eliminates the stuffing box** and an intermediate gear train. As a result, greater accuracy, quicker response

and low maintenance are advantages. And, because the register is tamperproof, the manufacturer will replace any register which fails within five years.

Replacing the conventional gear train and stuffing box are two permanent magnets. One magnet (3) is contained in the oscillating hard rubber piston (4) in the measuring chamber (7). The other magnet travels in a well in the sealed register (2). The force between them effectively transmits motion from the measuring chamber to the register with little friction.

Instrument-type gears are used in the register, permitting quick response and accurate movement. Only two parts are in contact with water, with all gearing hermetically sealed. Test meters have been ⅝ and ¾-in. Future sizes to 1-in. are planned, while the magnetic drive principle can be used in many larger and different kinds of meters. **Rockwell Manufacturing Co.,** 400 N. Lexington Ave., Pittsburgh 8, Pa.

Circle No. **13** *on Reply Card*



Rupture discs

. . . **for high temperature** and pressure conditions are made from corrosion resistant metals such as aluminum, copper and silver.

Model D discs are used only on systems operating under continuous pressure, while *Model DV* is designed for periodic or continuous vacuum conditions. The pressure type has two matched, prebulged discs which are assembled as a unit. The vacuum type has a third disc added as a support, which is welded to the other two units.

The metal tab attached to the rupture disc itself lists the conditions for which it has been designed. Both discs are available in ranges up to 1000 psi, but may also be designed to protect systems operating near or below atmo-

● Electrical brains are marvelous devices, but they can't help you determine which type of trap is best for any particular application. And using the same design of trap for all applications reduces condensate draining and air venting efficiency as much as 35%.

Five minutes spent with your Anderson representative will show you how the right type of trap for each application gives you maximum efficiency on each steam-using unit. He can quickly tell you the advantages of using inverted bucket traps for ordinary uses, thermostatic traps where freezing is a problem, and combination open float and thermostatic traps for extremely fast heating.

Call him in today. Learn the best trap to use on any given application.

SUPER-SILVERTOP
(inverted bucket)
for general use

QUIK-FLEX
(thermostatic)
for outside installation

HEAT-KWIK
(combination thermostatic and inverted bucket)
where fast heating up is required

ANDERSON FLOAT
(float)
where continuous float traps are required

THE V. D. ANDERSON COMPANY
division of International Basic Economy Corporation
1921 West 96th St. Cleveland 2, Ohio

Please send information on the following traps

☐ Super-Silvertop
☐ Heat-Kwik
☐ Quik-Flex
☐ Anderson Float

Name _____
Company _____
Address _____
City _____ Zone ___ State _____
☐ Have Representative Call

QUALITY STEAM TRAPS SINCE 1886

(To obtain more data on advertised products see page 158)

BROOKS LEADERSHIP
achieved through design

ROTAMETERS

a FULL LINE
for every service

Whatever your flow measurement or remote transmission needs . . . Brooks has the answer. Moreover, it is a *practical* answer . . . because the same practical design features are carried through the line. From Hi-Accuracy Flow Indicators to low-cost purge meters . . . from the well-known Ar-Met Armoured Meter to the new convertible electric or pneumatic flow transmitters, you'll find these common features: self-alignment of essential parts, simplified cleaning and assembly, and designs that eliminate troublesome line strain on the metering elements.

You can depend on Brooks rotameter equipment for *lowest final cost* all down the line—because it has been performance-proven where it counts most: in daily service.

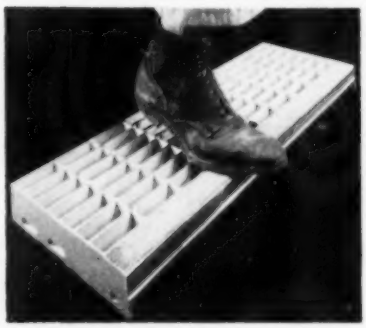
Send for your copy of Bulletin 110b, a brief, well illustrated guide to Brooks Rotameters and Accessory Equipment.

BROOKS ROTAMETER COMPANY
657 H Street, Lansdale, Pa.

the new standard of
flow measurement
and control

spheric. **Black, Sivalls & Bryson, Inc.** Product Information Dept., 7500 E. Twelfth St., Kansas City 26, Missouri.

Circle No. **14** *on Reply Card*

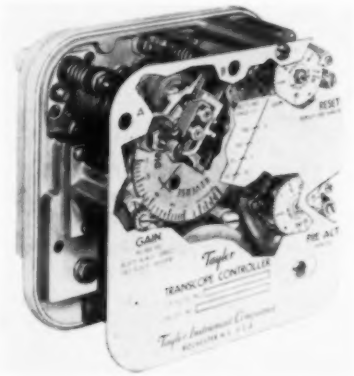


All-aluminum stair tread

. . . **is cast in one piece** and withstands loads of 1½ tons. Fused aluminum oxide abrasive is bonded to the nose plate to provide a rough, slip-proof surface.

Designed for extreme weathering and corrosive conditions, the stair tread is available in three finishes. It may be used "as fabricated" for structural purposes, it may be given a polished finish for inside use, or it may be obtained with an anodized surface for marine applications. Tread lengths range from 24 to 42 in. Width is a standard 10 in. **Aluminum Company of America,** 1501 Alcoa Bldg., Pittsburgh 19, Pa.

Circle No. **15** *on Reply Card*



Plug-in controller

. . . **can be mounted either** at the point of measurement or at the point of control. This compact (6 x 6 x 4½-in.) pneumatic controller is available with single or multiple control responses, with conversion to either one possible in the field.

The instrument uses a motion-balance principle through inter-connected multiple bellows and springs acting on a common force plate. Stainless steel, brass and aluminum are used throughout, accounting for a high degree of insensitivity to ambient temperature. **Taylor Instrument Companies,** Rochester 1, N.Y.

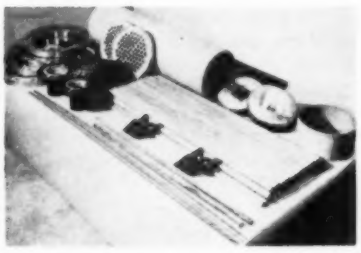
Circle No. **16** *on Reply Card*

Portable meter

. . . **measures explosive gases.** Concentrations below the lower explosive limit of the gas are registered on a direct reading explosive meter.

The instrument is factory calibrated for methane and ethane gases but can be obtained calibrated for other gases. Calibration curves show actual percentages for specific gases. Housed in a weather-proof metal case, the "Protector" operates on a 2-volt storage battery. A battery charger is provided with each unit. **Atlas Laboratories, Inc.,** Houston, Texas.

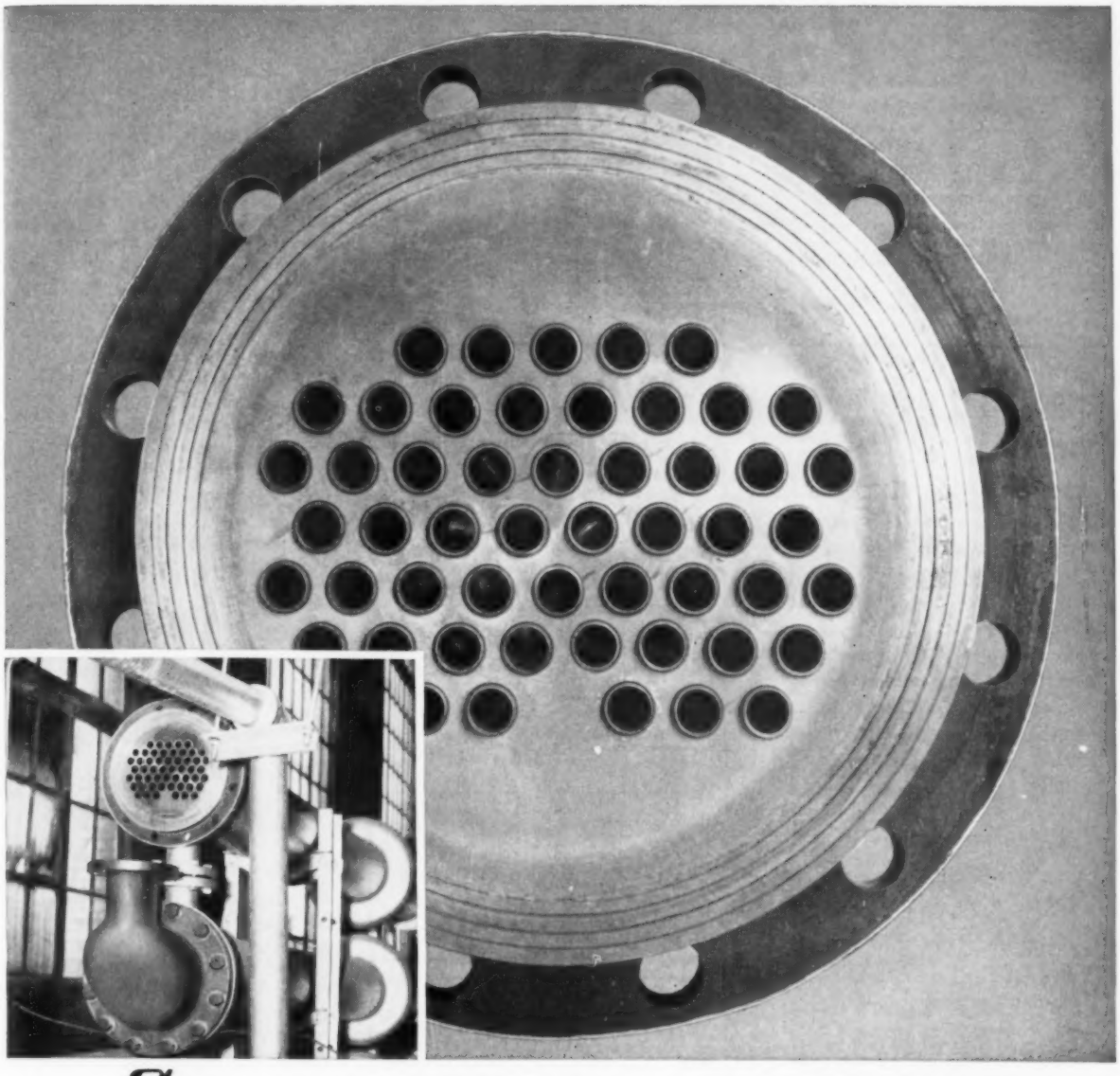
Circle No. **17** *on Reply Card*



Heat exchanger

. . . **from "off-the-shelf"** can be assembled from these component parts. Both single and double-pass carbon shell heat exchangers meeting ASME and TEMA codes can be fabricated.

Stainless steel heat exchangers are



Carpenter 7Mo Stainless Tubing

No corrosion . . . no pitting after 4 years of handling hot SO_2 gases and vapors

• The smooth, clean surfaces of the Carpenter 7Mo Stainless tubing in this 3-pass Relief Gas Cooler tell the whole story. Still like new after 4 years of carrying 8% SO_2 gases and vapors from the top of a sulphite digester at temperatures in excess of 200°F. No maintenance. No replacement worries. No costly downtime.

If you have a tough corrosion problem involving stress corrosion cracking and pitting, see what Carpenter 7Mo Stainless Tubing and Pipe can do to solve it for good. Call your Carpenter Distributor for service that satisfies.

MEMBER

The Carpenter Steel Company
Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter

more than corrosion resistance

Stainless Tubing & Pipe

(To obtain more data on advertised products see page 158)

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Are you an experienced engineer, draftsman, or checker nearing retirement age who is giving some thought to a move to a warmer climate? If so, we may have exactly what you are seeking in a Florida-type climate in one of the country's best fishing and hunting sections. No compulsory retirement age and many fringe benefits. Give full particulars, availability, income pattern, etc., to

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Are you a driving, intensely competent second or third ranking man in the engineering division of an old line pressure vessel company who is impatient to step into the top job *now*? If so, give us full particulars on yourself and we may have the opportunity for which you have been waiting.

•

P-5002 Petroleum Processing
520 N. Michigan Ave.,
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ENGINEERS, DESIGNERS AND DRAFTSMEN

FOR PLANT LAYOUT AND PIPING LAYOUT WORK

Permanent position offering challenging and varied assignments. Full application and appreciation of your training and experience assured because engineering designing and drafting is our business. University and technical night classes encouraged. High starting salaries and regular salary reviews. Housing, cultural and recreational facilities to suit every taste available in Cincinnati.

We pay moving costs.

Apply for interview by writing:

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Vulcan-Cincinnati, Inc.
120 Sycamore Street
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STEEL PIPE & TUBING

• Chrome Moly • Carbon Moly • Heavy Walls
• Carbon Steel • Stainless • Large O.D.
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

Need Engineers for Your Refinery .... Petrochemical Plant?

A solution to this problem can be obtained through an employment advertisement in our CLASSIFIED advertising section.

PETROLEUM PROCESSING
P.O. Box 12
New York 36, New York

available in a variety of prestocked sizes, ranging from 56 to 316 sq ft. Flange nozzles or couplings can be installed in any position required. Shell side baffles can be installed at any desired spacing.

Standard shell diameters range from 4½ to 20 in. These units are designed for 75 psi tube pressure and 150 psi shell side pressure up to 300°F. Slight modifications are required for higher pressures, and an expansion diaphragm can be added to meet higher temperature gradients. **The Pfaudler Co.,** 1036 West Ave., Rochester, N.Y.

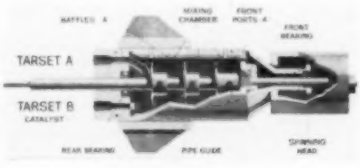
Circle No. **18** *on Reply Card*

Heavy-duty union

. . . **withstands 1,500 psi** steam at 900°F and is rated as a 6000 CWP forged-steel union.

These heavy wall unions are available in nine sizes, ranging from ⅛ to 2-in. The nut threads are rust-proof, spark-proof and permanently lubricated with cadmium to permit quick assembly. The ends are tapped to American Standard B 2-1 1945 (for tapered pipe threads). It is available in both threaded and socket weld types. **Clayton Mark & Co.,** 1900 Dempster St., Evanston, Ill.

Circle No. **19** *on Reply Card*



Plastic applicator

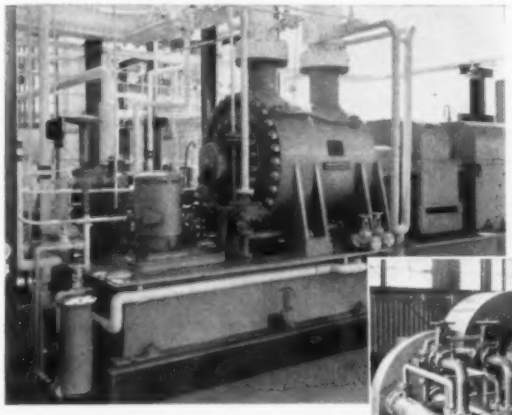
. . . **coats the inside** of 3, 4 and 6-in. pipe with a coal tar-epoxy resin in one pass. Film thickness is 15 to 20 ml.

Two novel features are incorporated in the applicator. First, the tar-epoxy

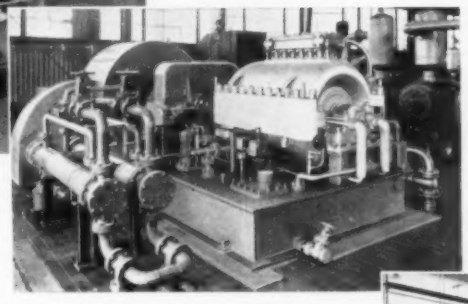
HOW 3 BASIC TYPES OF I-R

CENTRIFUGAL COMPRESSORS

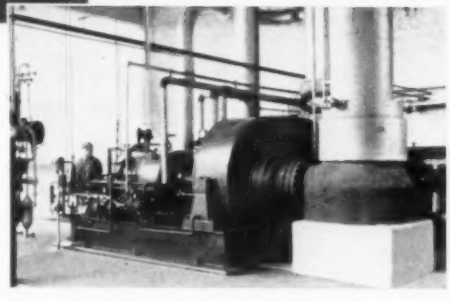
cover practically all of your process requirements



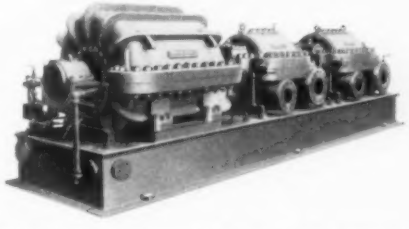
1. MULTI-STAGE VERTICALLY-SPLIT
Capacities to 9,000 cfm
Pressures to 2,200 psi



2. MULTI-STAGE HORIZONTALLY-SPLIT
Capacities to 165,000 cfm
Pressures to 625 psi



3. SINGLE-STAGE
Capacities to 255,000 cfm
Pressures to 1,000 psi



Typical series combination of three multi-stage horizontally split centrifugal compressors mounted on a single base and arranged for a common drive.

Here are the three basic types of Ingersoll-Rand centrifugal air and gas compressors. The complete range of sizes available in each type provides extremely wide latitude to meet process conditions. By combining two or more individual units of the same or different types in tandem or in series, a great range of capacities and pressures are obtainable (units up to 2,000 psi have been furnished).

Any type of drive can be used and combination units can be individually powered or driven from a single source — electric motor, steam turbine or gas turbine. This flexibility of application is one reason why more and more I-R centrifugals are being installed in all types of process service.

Ingersoll-Rand has supplied more horsepower of industrial centrifugal compressors and Turbo-Blowers than any other manufacturer. This long experience means greater dependability, higher sustained efficiency and less maintenance expense. If you have a process compression problem, call in your I-R engineer. His experience in this specialized field can save you time, effort and expense from initial planning to on-stream operation.

12-404

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS AND DIESEL ENGINES • ROCK DRILLS • PUMPS • TURBO-BLOWERS • AIR AND ELECTRIC TOOLS

J-M BLAZECRETE builds longer lasting refractory linings...

That's why it pays you to use this hydraulic setting refractory for temperatures to 3000F

Blazecrete* linings last longer because they resist spalling, withstand slagging action, and are not harmed by rapid temperature changes.

Thus you cut down on refractory maintenance costs—and you save on labor costs, too, because Blazecrete goes on fast. For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place. When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete may be applied easily without laborious ramming or tamping.

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix—can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic-setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

Johns-Manville **BLAZECRETE**

BUILDS BETTER REFRACTORY LININGS

blend and its catalyst are fed separately into the applicator in carefully controlled proportions. High-speed mixer blades thoroughly blend the two components in a few seconds. This eliminates error in mixing as well as the problems of pot-life encountered in large batches.

Second, the mixed material is expelled from the mixing chamber under positive pressure into a spinning cylinder which centrifugally casts the mixture evenly on the inside of the pipe. The machine is not on the market but Pittsburgh Coke & Chemical will offer technical assistance to any interested parties. **Pittsburgh Coke & Chemical Co.,** Protective Coatings Division, Pittsburgh, Pa.

Circle No. **20** *on Reply Card*

Petroleum additive

. . . **is an antioxidant** for gasolines, jet fuels, lubricating oils, fuel oils and other petroleum products. "Dav-Ad 101" is known technically as an alkylated phenol, 2,6-di-teriary-butyl-4-methyl-phenol.

This material is a white flake, nontoxic product that can also be used in natural and synthetic rubber tires and plastics as a non-staining antioxidant. It is available as a 100% flake material or as a 33⅓ solution in toluene **Davison Chemical Co.,** Baltimore, Md.

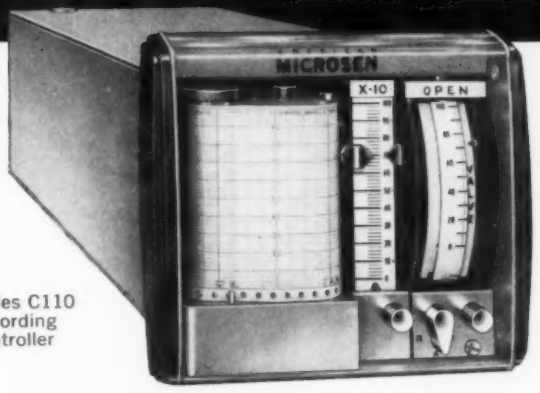
Circle No. **21** *on Reply Card*

Heat-exchange fluid

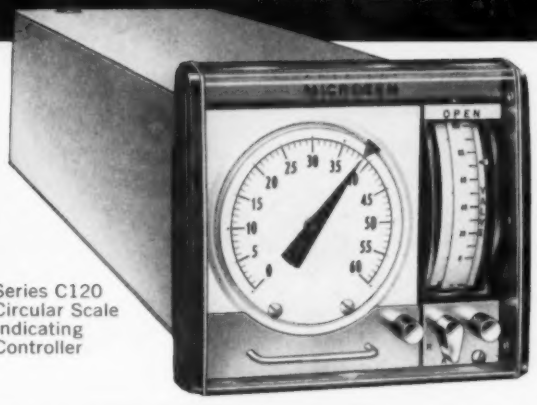
. . . **is also a coolant-moderator** for nuclear reactors. Developed in a series of tests in 1955 for the AEC, this commercial derivative of biphenyl is now available in pilot plant quantities.

Isopropylbiphenyl not only slows down the high-speed neutrons in a reactor but can also remove some of the tremendous heat built up within the reactor core. The material has

NEW TRANSISTORIZED ELECTRONIC CONTROLLERS Interchangeable for complete versatility



Series C110
Recording
Controller



Series C120
Circular Scale
Indicating
Controller

The new 'American-Microsen' Series C100 Electronic Controllers can be interchanged at the panelboard in seconds. A recording controller to an indicating type . . . a proportional-action controller to proportional-plus-reset . . . slow reset to fast reset – any of these replacements is quickly made by pulling one unit out and plugging in the other.

The controller settings of the 'American-Microsen' System are all calibrated and repeatable. When a controller station is replaced, the proportional, reset and rate settings can be made in advance so the process is on control the instant the changeover is completed. No playing around to tune in the control.

When the process is on manual control during a replacement operation, the controller station stays in balance with the actual valve position. Thus the process can be changed back to automatic control without "bumping" or upset. A unique feature of the 'American-Microsen' System eliminates any "balance" or "seal" position between manual and automatic.

These are but a few of the many functional advantages of the new 'American-Microsen' Electronic Control System. Join the many satisfied users of this new approach to process control. Make certain you have the better control and simplified servicing so essential to higher product quality and greater operating economy. Arrange for a meeting with one of our sales engineers to determine the best equipment for your service. *Write for Bulletin RC100.*

Controller Performs These Functions

Measures input signal from transmitter and records or indicates in terms of the measured variable — pressure, temperature, flow, etc. (The Series C110 records on a 3-inch wide strip chart, the Series C120 indicates on a 4-inch diameter scale.)

Provides means of setting the desired value of the measured variable (set point) and compares actual value with desired value.

Transmits control signal, incorporating proportional, reset, and/or rate actions to operate final control element.

Provides means to operate control element manually with simple switch and manual knob.

Ultra-Modern Features Provided

All functions of recording (or indication), controlling (proportional, reset, and/or rate), and manual valve operation *in a single housing.*

Transistorized controller station for ultimate reliabil'ty and long service life.

Printed circuitry and miniaturized components for space-saving simplicity.

Plug-in units for complete interchangeability and ease of maintenance.

Ratio, cascade, and other similar control arrangements, using standard instruments.

Direct bumpless transfer from manual to automatic control with no intermediate position.

DC signals of 1.0 to 5.0 milliamperes for instantaneous distance transmission up to 30 miles.

Controllers are compatible with any unit of other manufacture using the standard 1 to 5 milliampere DC signal.

MANNING, MAXWELL & MOORE, INC.

MAXWELL MANNING & MOORE INC. TRADE MARK

INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

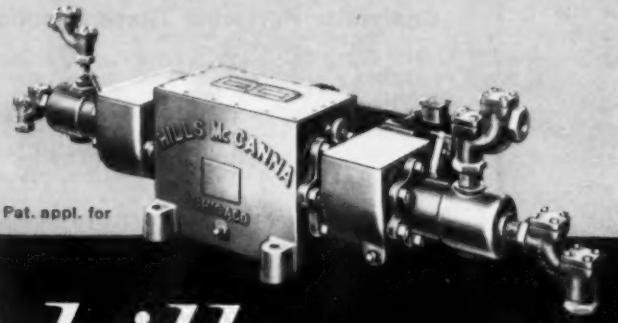
MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL

(To obtain more data on advertised products see page 158)

Accurate Proportioning of Fluids

Hills-McCanna Metering and Proportioning Pumps

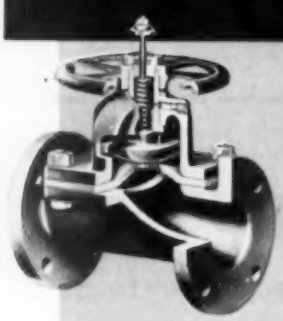
Hills-McCanna Proportioning Pumps are designed for dependable precision metering and simplified maintenance. Ranging in capacity from a few cc to hundreds of gallons per hour, they may be adapted to automatic operation. Write for the valuable booklet "Precision Proportioning Pumps" for complete information.



Pat. appl. for

hills-mccanna company

THE PEOPLE WHO KNOW AND CONTROL FLOW



DIAPHRAGM VALVES

...provide leak-tight, dependable valve performance for corrosive services, slurries, liquids, gases, air and water; feature simplified in-line maintenance, exclusive sealing bead diaphragm. Write for informative catalog on complete valve line.

Hills-McCanna Company 2488 W. Nelson Ave., Chicago 18, Illinois

the big advantage of being noncorrosive and usable at low pressure. As a result, the construction cost of reactors, which would otherwise use corrosive water as a coolant-moderator, may be sharply reduced.

Although subject to some irradiation damage, the resulting impurities in the isopropylbiphenyl are easily distilled from the system. This organic coolant also picks up little radioactivity during use in the reactor, offering possibility of reduced shielding. **Monsanto Chemical Co.,** Organic Division, 1700 S. Second St., St. Louis 4, Mo.

Circle No. **22** *on Reply Card*

Detector kit

. . . **pick up vapors** of TDI (toluene di-isocyanate) and TDI-urea in concentrations of less than 0.1 ppm in air. The portable kit can be operated while being carried.

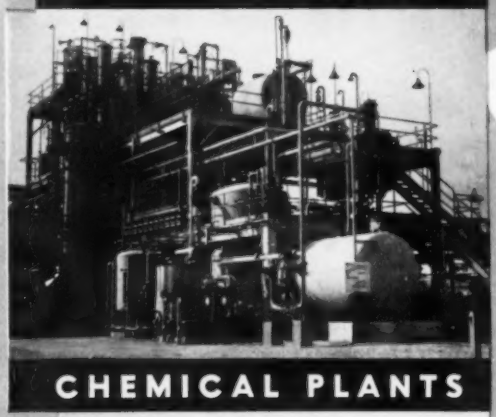
A hand-cranked, four-cylinder pump with regulator and timer draws samples of air for three minutes through an all-glass impinger tube. The 15 ml of dilute aqueous acid solution will hydrolyze to an amine if the TDI

• • •

(To obtain more data on advertised products see page 158)

DROP FORGED STEEL

valves, fittings and flanges by Vogt



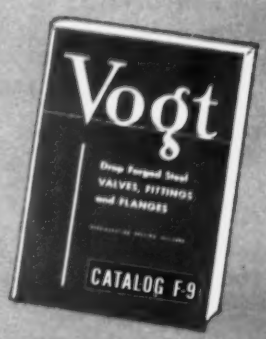
USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.

Dept. 24A-FPP

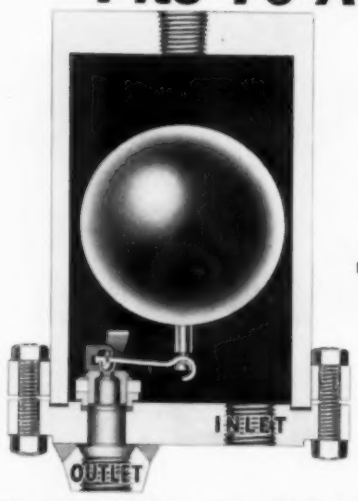


HENRY VOGT MACHINE CO. ... 75th Anniversary ... LOUISVILLE, KY.

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

CLARK "T"

Fits To A



Duo-Step Leverage • Low Maintenance

Greater Capacity

Less Cost

Ask Your Distributor For These CLARK Fluid Controls

Inverted Bucket Traps	Venting Traps	Pressure Regulators
Open Bucket Traps	Thermostatic Traps	Y-Type Strainers
Float Traps	Vacuum Traps	Pressure Reducing Valves

STANDARDIZE ON THE COMPLETE CLARK LINE

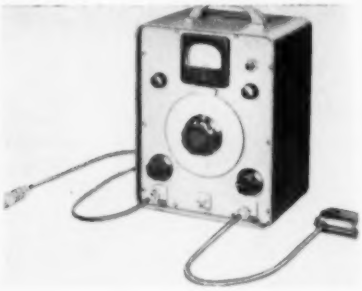
ASK YOUR DISTRIBUTOR OR WRITE DIRECT FOR FREE BROCHURES ON CLARK FLUID CONTROLS

THE Clark MANUFACTURING COMPANY

1832 East 38th St. • Cleveland 14, Ohio

vapors are present. The amine is converted to a diazo-amine compound, and it will turn pink when a liquid reagent is added. Comparative color standards in the kit represent 0.05, 0.10 and 0.20 ppm. **Mine Safety Appliances Co.,** Pittsburgh, Pa.

Circle No. **23** *on Reply Card*

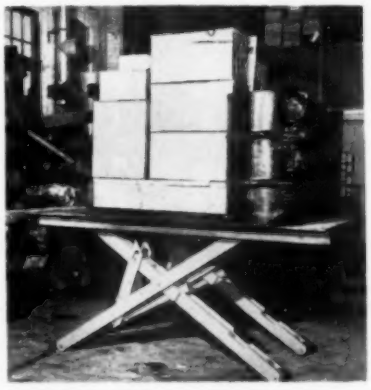


Pressure indicator

. . . **also measures rate of pressure change.** A standard model measures pressures from 0.1 through 3,000 psi, and with an adaptor it can measure pressures up to 25,000 psi. Continuous operation at 600°F is possible without cooling the crystal transducer.

Using a Swiss-made quartz crystal pickup, the Kistler SLM indicator has a fast response to pressure changes (15 micro second rise time) and high sensitivity. It can be calibrated by conventional methods and has a constant calibration factor independent of the temperature. **Kistler Instrument Co.,** 15 Webster St., North Tonawanda, N.Y.

Circle No. **24** *on Reply Card*



Lift platform

. . . **is portable** and requires no installation. It can be used in almost every location for lifting and loading material between two different levels.

The Porta-Contact Lift Platform has a standard 6 x 8 ft platform that

13 MILLION GALLONS BIG...BUT JUST A DROP IN THE BUCKET

The ESSO WASHINGTON is the newest of the 110 ocean-going tankers in the Esso fleets. She can carry 13 million gallons of oil. But that's just a drop in the bucket compared with the 40 billion gallons that Jersey Standard affiliates delivered to customers last year.

As economies expand . . . as populations grow . . . as people live better, oil must provide more energy to power factories, to drive ships and planes and motor vehicles, to heat and light homes and offices. Last year we supplied more than twice the oil we did ten years ago. This year our customers will need still more.

It's a big job . . . and it requires vast amounts of costly equipment. As our Annual Report points out, we spent $1,083,000,000 last year searching for oil and gas and paying for such things as tankers, pipelines and refineries. And in 1957, we plan to spend another $1,250,000,000 to find, produce and deliver the oil people will be needing tomorrow...and ten and twenty years from now.

Because Jersey Standard is willing and able to make such investments and because our operations are efficient, we make a profit. In 1956 it was $808,535,000. About half of it went back into the business to help pay for the new facilities.

Our successful year was good news for the 403,000 shareholders who own the company . . . they got dividends of $2.10 per share on the money they invested.

It was good news for our 156,000 employees . . . whose wages and benefits came to $906,000,000.

It was good news for governments. Operating and income taxes, import duties, consumer taxes and other payments from our operations brought to the United States and other governments a record $2,171,000,000. That was five times the dividends to shareholders, more than double the payroll and benefits to employees.

Best of all, our operations were good news for the people of the free world, who rely heavily on the energy of oil for their economic and social progress.

In this, our 75th anniversary year, we intend to continue our efforts to remain successful, profitable and growing, in order to serve people well.

If you would like a copy of our 1956 Annual Report, write us at Room 1626, 30 Rockefeller Plaza, New York 20, N. Y.

Esso 75 YEARS

STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES

producing energy for an abundant life

(To obtain more data on advertised products see page 158)

Viscometer for more-efficient Refinery Control!

Hallikainen-Shell Development Co. Continuous-Indicating & Recording Viscometer

For measuring the viscosity of petroleum products with an overall accuracy of better than 1% of full-scale reading.

This instrument placed at the process unit not only decreases the cost of laboratory analysis, but also aids the operator in more efficiently controlling refining operations. Here are two examples:

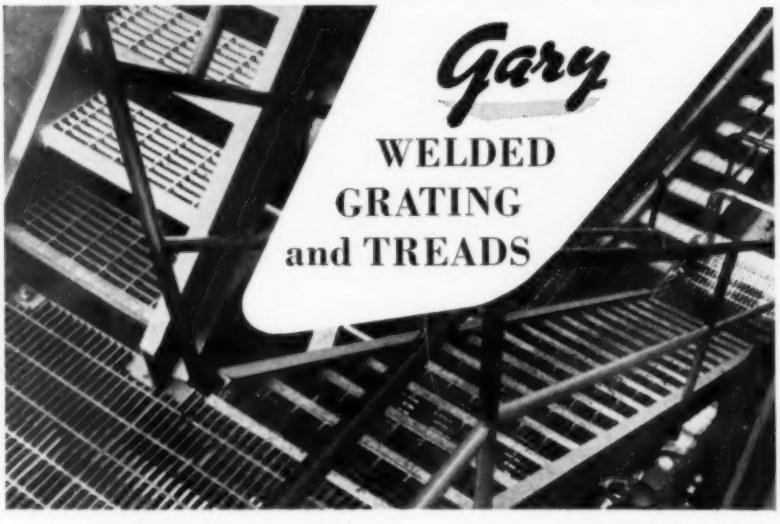
At a Dubbs unit a record was obtained of viscosity of the final blend of all streams comprising residual fuel-oil production. Having a continuous record of viscosity, closer control achieved a saving of 1 per cent of premium furnace oil from a residual fuel-oil stream of 17,000 B/D.

Another application on a lube-plant HVI column gave better control of cut points. Precise control of viscosity resulted in processing 600 B/D more of bright stock in MEK dewaxing unit because of increased filtration rates with better yields of finished product.

Ask for full details about this more-accurate time-saving Hallikainen-Shell Development Continuous Indicating and Recording Viscometer. Write today.

Color Alarm • Thermometer Calibration Baths • Hydrogen Analyzer • Radiological Gas Analyzer • Alkylation Acid Analyzer • and other analytical instruments for continuous processes.

HALLIKAINEN *Instruments*
Industrial and Scientific
1341 Seventh Street, Berkeley, Calif.



Get all the facts. Write for Bulletin

- **TAILOR MADE**—for most economical installation.
- **RIGID STRENGTH**—sturdy resistance-welded construction.
- **LIGHT WEIGHT**—for greater load bearing capacity.
- **SELF-CLEANING**—for reduced maintenance costs.
- **OPEN CONSTRUCTION**—gives maximum ventilation and illumination.

Write for bulletin PP-67

ROCKWELL SRA

ROCKWELL SPRING & AXLE CO.
Standard Steel Spring Division
4016 EAST SEVENTH AVE., GARY, INDIANA

supports up to 5,000-lb loads. It can lift loads from a lowered height of 4½ in. to a full height of 64½ in. Lifting power is supplied by a 1 HP electric-hydraulic unit. Design of the unit is such that any kind of power failure will freeze the platform in that location; it will not lower until full repair is made.

Special models can be obtained which will support loads up to 100,000 lb. **Autoquip Corp.,** 1140 S. Washtenaw Ave., Chicago 12, Ill.

Circle No. **25** *on Reply Card*

Electronic blender

. . . **may be located** many feet from the blending process eliminating the need to pipe the blended components to a control station.

In a typical case, a flow meter will transmit to this "Blendtrol" an electric signal proportional to the flow rate of the major component being blended. The desired percentage of the additive is set on the ratio dial. Regardless of flow variations in the main component, the preset ratio is maintained in the additive through a Shaftrol or Valvetrol. These are electric devices furnished by this manufacturer, which regulate variable displacement or variable speed metering pumps or valves.

The system operates on plant light circuit if desirable. All units can be furnished in explosion proof enclosures. **The Jordan Co.,** 3235 West Hampton Ave., Milwaukee 9, Wis.

Circle No. **26** *on Reply Card*

Free trade literature

Gas chromatograph

. . . for continuous analysis of process streams: *Brochure G HGZ* graphically tells how this instrument works and how it can be used for process control and analysis. Process Instruments Division, Beckman Instruments, Inc., Fullerton, Calif.

Circle No. **27** *on Reply Card*

Fuel injection

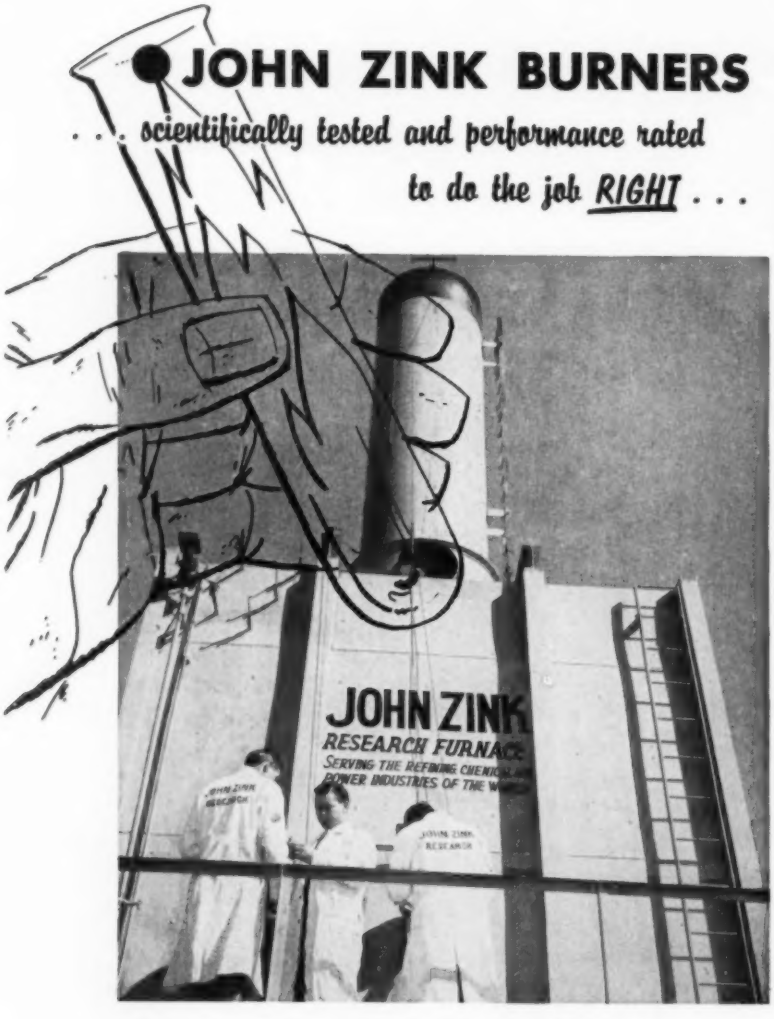
. . . for diesel engines: *Bulletin 950138* describes a fuel metering system based

precision
"Hair-splitting" is a kind of conversational precision hardly calculated to win friends and influence people.
At K&M, hair-splitting precision is more than a matter of talk.
For example, vital valve guides and bushings are precisely machined to a super finish of eight micro-inches or better.
But nobody takes anybody else's *word* for it. K&M's quality control men use a total of eight hundred and fifty-four separate dimensional tests in checking out each valve.
Sound like a lot? It is. Such meticulous precision is the kind of thing control engineers talk about when they get down to the business of specifying valves.
Many are convinced that K&M quality control means better, more accurate process control.
K&M
KIELEY & MUELLER, INC.
diaphragm control valves
Our 78th Year
Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

(To obtain more data on advertised products see page 158)

JOHN ZINK BURNERS

. . . scientifically tested and performance rated to do the job RIGHT . . .



This research furnace affords an ideal proving ground for design changes in standard lines of burners, as well as enabling the John Zink Company to find *workable* solutions to new problems. In this way the John Zink Company can offer you special burners for your individual application . . . burners that have been *performance tested* before they reach your job site.

→ *The facilities of the John Zink research furnace are available to industry.*

WE MAKE HEAT . . . AROUND THE WORLD

If you have a specialized industrial burner problem . . . JOHN ZINK has the answer . . .

JOHN ZINK COMPANY

4401 SOUTH PEORIA TULSA 5, OKLAHOMA

on pressure and time. The pressure at the metering opening is controlled by the throttle, and the metered opening is uncovered for a certain interval determined by the engine's rotative speed. The operation of the system is well explained in a 4-color diagrams of the various parts of the injection system. Cummins Engine Co., Inc., Columbus, Ind.

Circle No. **28** *on Reply Card*

Concrete repair

. . . with "Permagile," a plastic alloy: *Permanent Repair of Masonry Structures* is a short paper describing this thermosetting plastic that welds concrete and other masonry. It neither shrinks nor expands, is waterproof, is strong and tough, and is physically and chemically stable. Permagile Corporation of America, 37 Thirty-third St., Long Island City 1, N.Y.

Circle No. **29** *on Reply Card*

Prestressed concrete

. . . in the petroleum industry: *Preload Bulletin T-14* is an up-dater on the new uses that this construction material is finding in the petroleum industry. Described in detail are the advantages that users have found in tanks made from prestressed concrete, as well as firewalls and shell foundations. The Preload Co., 211 East 37th St., N.Y., N.Y.

Circle No. **30** *on Reply Card*

Data folder

. . . on two glycols, diethylene and triethylene: *Form F-8085A* offers data on physical and physiological properties, as well as specifications and applications. These glycols are used for their hygroscopic properties, particularly for removing moisture from gases. Carbide and Carbon Chemicals Co., 30 East 42nd St., N.Y. 17, N.Y.

Circle No. **31** *on Reply Card*

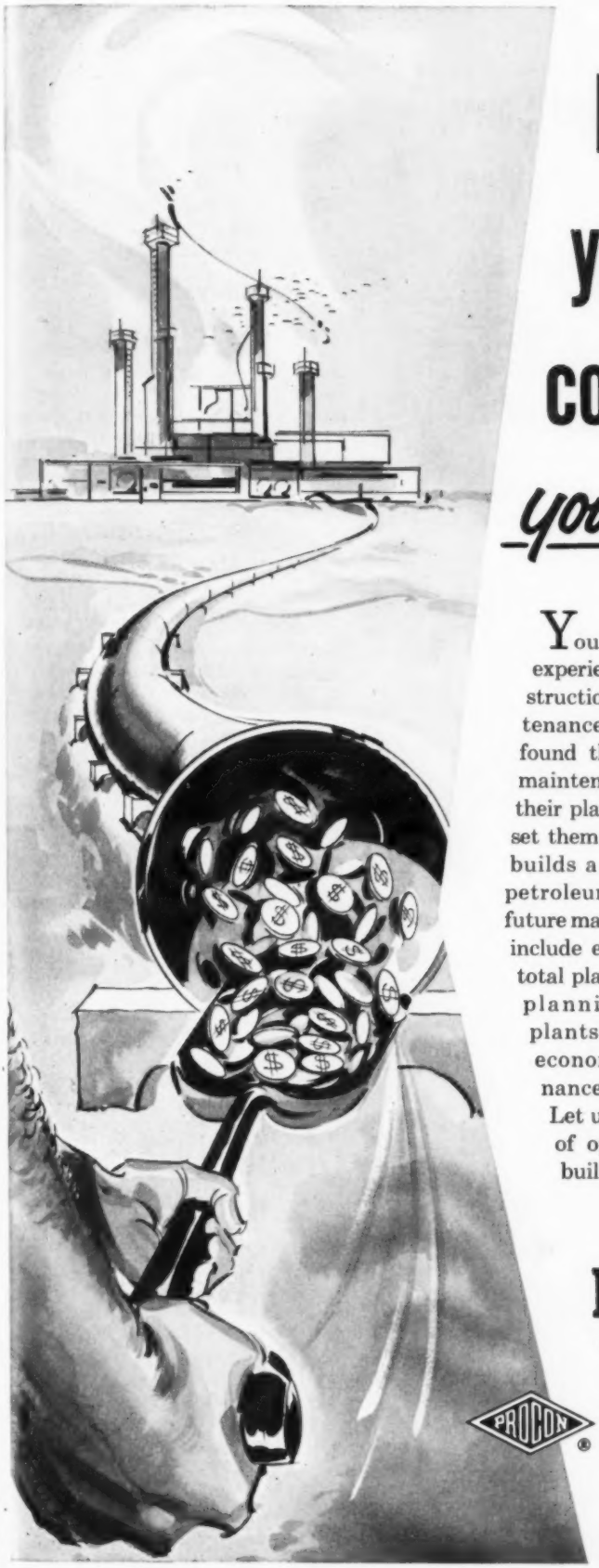
Data book

. . . for the selection and design of Poly-V drives: *Data Book No. 10* is a 114-page manual that deals in detail with this patented belt for transmitting power. The book also includes information on the use of multiple V-belts. Raybestos-Manhattan, Inc., Passaic, N.J.

Circle No. **32** *on Reply Card*

Liquid Hypalon

. . . for coatings of extreme chemical and heat resistance: *Rubber-Coat Liquid Hypalon* describes some of the



How much will your new plant cost.... *after you've paid for it?*

You may have learned from bitter experience that original design and construction can vitally affect your maintenance costs. Many executives have found that a big worry today is high maintenance costs, because yesterday their plant was not best planned to offset them. The way Procon designs and builds a chemical, petrochemical or petroleum refining plant helps keep future maintenance costs low because we include evaluation of the economics of total plant operation and upkeep in our planning. There are Procon-built plants all over the world operating economically today on this maintenance-minded construction principle. Let us show you how ease and economy of operation and maintenance can be built into your plant.

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U. S. A.

PROCON (CANADA) LIMITED, TORONTO 18, ONTARIO, CANADA

PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND

PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

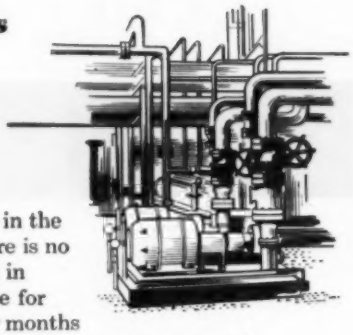
WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

(To obtain more data on advertised products see page 158)

Positive Proof...

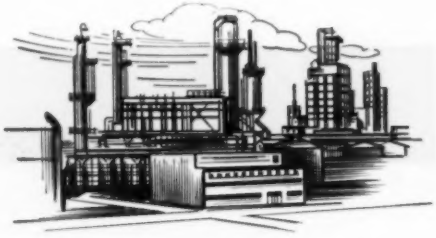
The John Crane® Type 9 Shaft Seal Solves Those Tough Liquid Handling Problems

Actual Field Reports



from an Arkansas Refining Plant

When it comes to avoiding trouble in the handling of naphtha at 420°F., there is no substitute for positive sealing. And in cases like this there is no substitute for "John Crane's" Type 9 Seal. Many months of completely satisfactory operation offers convincing proof.



from a Louisiana Refinery

It takes a "lot of shaft seal" to handle a highly corrosive mixture such as an emulsion of sulphuric acid and butane. This stuff plays real havoc with metals due to its corrosive action. Despite this, Type 9 Seals on twenty seven pumps are pumping month after month in continuous service. At this same location, other Type 9's are effectively handling "fresh" sulphuric acid at the high suction pressure of 400 psi.

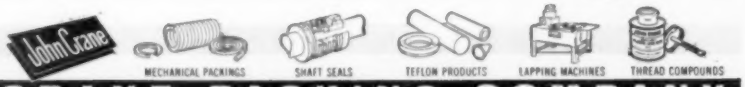
In cases like these . . . and in those confronting you . . . the surest answer is the "John Crane" Type 9 Seal.

CONDENSED SPECIFICATIONS

Recommended services: all industrial chemicals, corrosives, liquids or gases. Temperatures: −120°F. to +500°F. Pressures: up to 750 psi. Construction: Sealing members of chemically inert DuPont Teflon, metallurgy best suited to service requirements.

Send us your problems. Request Bulletin S-205-2.

Crane Packing Company, 6432 Oakton Street, Morton Grove, Illinois, (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.



CRANE PACKING COMPANY

many uses for this Du Pont chlorinated polyethylene that has been compounded as a paint. It may be brushed or sprayed and dries in twenty minutes. Self-curing continues over a period of 30 days to give a protective coating resistant to many chemicals. Wilbur & Williams Co., 130 Lincoln St., Brighton 35, Mass.

Circle No. **33** *on Reply Card*

Meter-relays

. . . for adjustable on-off control: *Catalog No. 4C, March, 1957* is more than just a listing of the types of meter relays sold by this manufacturer. Included is a technical section on how this meter works, its circuitry, and operating characteristics. Assembly Products, Inc., Chesterland 1, Ohio.

Circle No. **34** *on Reply Card*

Air pollution photometer

. . . for measuring the dust load in any atmosphere: *Bulletin JM-1000-C* describes the operation of this commercial, portable instrument developed in 1953. It can be used for continuous monitoring of dust particles, through optical comparison, for controlling smog conditions. Phoenix Precision Instrument Co., 3803 N. Fifth St., Philadelphia 40, Pa.

Circle No. **35** *on Reply Card*

Diesel troubles

. . . can be spotted with this wall chart: *Principles of Trouble Shooting for Cummins Diesels* is a check chart for locating and correcting troubles in the air, fuel, lubricating or cooling system of diesels. Poor operating or maintenance practices can also be defined by using this chart. Service Division, Cummins Engine Co., Inc., Columbus, Ind.

Circle No. **36** *on Reply Card*

Engineering-construction

. . . for the petroleum industry: *Bulletin No. 2547* is a 28-page brochure listing the broad line of petroleum processes which this company can design and build. Throughout the booklet are pictures of the many basic, intermediate and finishing processing plants which have been built for the oil industry. Blaw-Knox Co., Chemical Plants Division. Pittsburgh 22, Pa.

Circle No. **37** *on Reply Card*

V-drive catalog

. . . for fractional to 10 hp drives: *Form F-10* is a 46-page source of information for designing and specifying

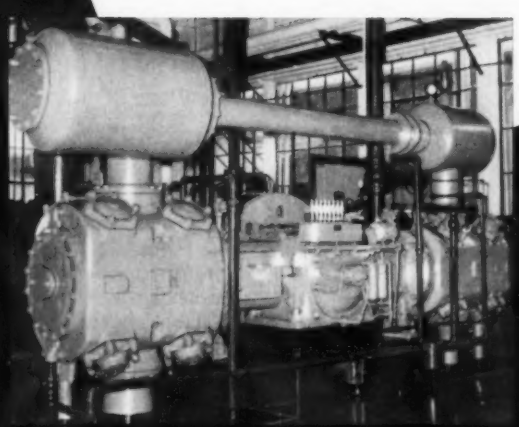
Gene:
Here's another excellent customer report of Cooper-Bessemer compressor performance.
Mike

*Excerpt from a letter written by the Plant Engineer of one of Firestone's foreign subsidiaries.

*This is one piece of equipment we are very happy to recommend to all prospective customers of Cooper-Bessemer. Since this unit was installed, it has operated over 13,800 hours, 6 days a week, 24 hours per day without down time for maintenance. It has given continuous service at rated capacity with no production stoppage or material spoilage.

Very truly yours,

Plant Engineer



Cooper-Bessemer motor-driven EM compressor in a tire manufacturing plant of The Firestone Tire and Rubber Company. This heavy-duty unit, rated 200 hp at 450 rpm, efficiently handles the compression of air from atmosphere to 100 psig.

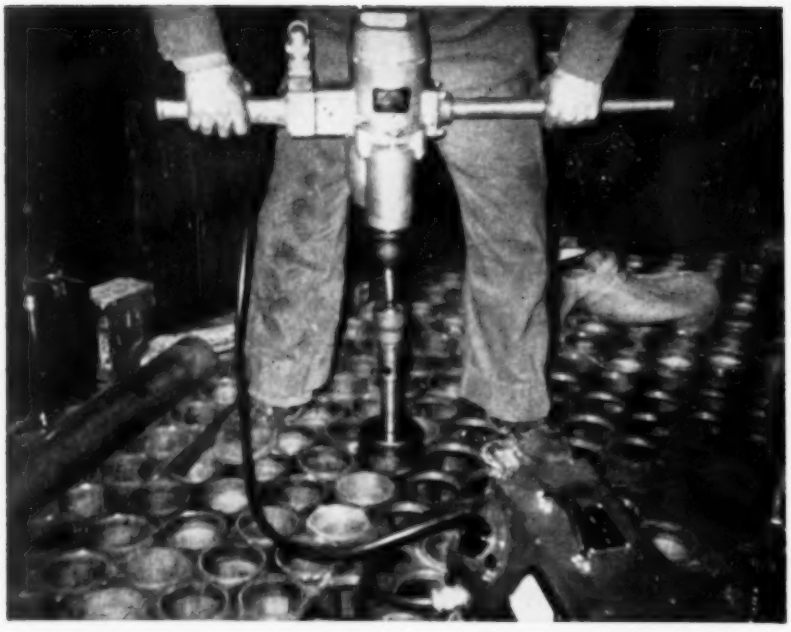
BRANCH OFFICES: Grove City • New York
Chicago • Washington • San Francisco • Los Angeles
Houston • Dallas • Odessa • Pampa • Greggton
Seattle • Tulsa • St. Louis • Kansas City • Minneapolis
New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Limited . . . Edmonton • Calgary • Halifax.
Cooper-Bessemer International Corporation . . . New York • Chacao • Havana • Mexico City.

Cooper/Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES · GAS · DIESEL · GAS-DIESEL
COMPRESSORS · RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN



850 tubes rolled in less than 5 hours!

AIRETOOL Automatic Tube Expansion Control System simplifies and speeds accurate tube rolling!

A large coppersmithing company* recently faced one of the biggest tube rolling and expanding jobs of its kind when they had to roll 850 4 in. OD x 13 gage copper tubes in a limited time. Using AIRETOOL'S Automatic Tube Expansion Control System, they rolled those tubes at a rate of one every twenty seconds . . . completed the job in *less than five hours!*

You too, can shorten tube rolling time immensely . . . eliminate costly over-rolling, over-expanding and distortion of tube sheets . . . with AIRETOOL'S Automatic Tube Expansion Control System. Ask for an ON-YOUR-JOB demonstration, today. *Name upon request

SOLVE ALL YOUR TUBING PROBLEMS, FROM INSTALLATION TO REMOVAL, WITH AIRETOOL TUBE MAINTENANCE EQUIPMENT

CONDENSER CLEANERS

Outside mounted . . . direct or gear driven. Powerful . . . fast . . . lightweight. Clean lightly scaled or completely plugged tubes to 1". Built-in flushing system cools drill, removes chips.

CONDENSER TUBE EXPANDERS

Parallel rolling . . . self-feeding . . . ball bearing thrust collar. Roll tight accurate tube joints to uniform expansion and tightness with maximum bonding.

TUBE CLEANERS

Powerful . . . fast cutting . . . quickly, completely remove hardest deposits. Air Driven motors in wide range of sizes and speeds.

Write for illustrated literature, (Bulletin 60), showing AIRETOOL'S complete line of tube maintenance equipment.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.
REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.

EUROPEAN PLANT: Vlaardingen, The Netherlands. CANADIAN PLANT: 37 Spalding Drive, Brantford, Ontario.

V-belt driven equipment. Topics treated include interchangeable bushings, pulleys, accessories, V-link belting and general engineering data. Requests for a copy of this catalog should be sent on company letterhead to Catalog Division, Maurey Manufacturing Corp., 2915 S. Wabash Ave., Chicago 16, Ill.

Do not use Reply Card

Asphalt additives

. . . permit work during rainy weather: *Redicote Anti-stripping Agents* is a leaflet describing the uses of cationic chemicals which permit asphalts to adhere to wet or otherwise difficult-to-coat aggregates. Usable on either acidic or basic aggregates, these chemicals can be added in the asphalt plant or directly in the mixer at the job. Armour and Company Division, 1355 W. 31st St. Chicago 9, Ill.

Circle No. **38** *on Reply Card*

Centrifugal castings

. . . for stronger, sounder furnace tubes: *Bulletin T-283* describes the different types of pipe and fittings that can be produced by the new method of casting. Physical properties of the common grades of Thermalloy centrifugally cast tubes are listed. Electro-Alloys Division, American Brake Shoe Co., Elyria, Ohio.

Circle No. **39** *on Reply Card*

Cooling towers

. . . described and pictured: *Bulletin No. CT-57-1* is a 30-page brochure listing the advantages of the mechanical induced-draft, counter-flow tower. A complete description of the method of constructing these towers is shown throughout the booklet. Foster Wheeler Corp. 165 Broadway, N.Y. 6, N.Y.

Circle No. **40** *on Reply Card*

Fluorescent testing

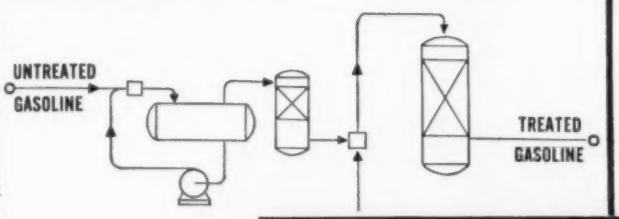
. . . for small cracks in metal: *Form 1669-25M* is a manual on fluorescent penetrant materials and how to use them. Illustrations of typical examples are printed in a fluorescent ink that almost duplicates test conditions. Magnaflux Corporation, 7300 W. Lawrence Ave., Chicago 31, Ill.

Circle No. **41** *on Reply Card*

Flexible valves

. . . for corrosive and abrasive conditions: *Catalog No. FL-1116* is in two parts. The first 26 pages describe the construction of manual and diaphragm-operated valves, available in

TC SWEETENING



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Tennessee's Copper Chloride was developed to effect efficient Mercaptans removal.

Place your confidence in a basic producer of Copper Chemicals.

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Other products of interest— Ferric Sulfate—Copper Sulfate, Copper Oxide—Sulfur Dioxide.

For samples make request on your company letterhead.

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617-629 Grant Building, Atlanta, Ga.

☞ IN THE **JULY** PETROLEUM PROCESSING

The complete technical story of the

TIDEWATER

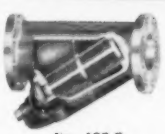
DELAWARE REFINERY

☞ **64 PAGES OF FEATURE ARTICLES**—Why and how Tidewater selected the site. . . . How the 11 major processing units are integrated and how they work. . . . What it takes to back up the processing units—electrical system, water supply, instrumentation, automatic blending, waste disposal, tankage, contract maintenance. . . . People—training new operators; making friends with new neighbors.

A Contamination-Free Product—
Protect pumps, meter, product

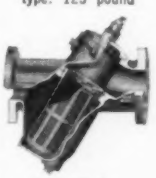
No. 187
Bottom Outlet
Type

WITH OPW
line strainers



No. 187-F
Bottom opening
type. 125 pound

No. 387
Top outlet type.
125 pound.



No. 387-F
Top outlet type
flanged. 125 pound.

No. 487-F
Top outlet type
flanged. 200 pound.

OPW Line Strainers remove dirt, scale, rust and other solids from liquids flowing in any pipe line system. This positive screening-out process protects and prolongs life of pumps, meters, loading valves, and mechanical equipment. Pipe-snug fit of cage and screen, plus larger than pipe size screen area, assures *free* and *complete* flow of product through strainer. Screens can be quickly and easily removed for periodic check-ups, cleaning and replacement.

Bulletin F-36 gives full details on sizes, styles, screen mesh, etc. Write today.

JORDAN CORPORATION
Division of OPW Corporation
6013 Wiehe Road Cincinnati 13, Ohio
ELmhurst 1-1352

(To obtain more data on advertised products see page 158)

thrifty...
versatile
EASTERN
PORTABLE
MIXERS
Portable mixers provide the thrifty answer to many mixing problems. Versatile Eastern Mixers can be quickly shifted from task to task to allow one mixer to serve many needs.
Available from 1/20 to 5 H.P. with a variety of speeds and motor enclosures, your small investment in an Eastern Portable quickly pays for itself even if your needs are infrequent and varied.
For complete portable mixer information, write for Eastern Bulletin 520-B.
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INDUSTRIES, INC.
Regent St., E. Norwalk, Conn.

SHOP TIP
For an Easier Way to Remove Packing
Here is a rugged, flexible, hand-tool that "works around corners" for removing old packing from stuffing boxes. The picture above shows how Dura Hooks operate around obstructions. All steel—tempered steel cork-screw bit—made in 6 sizes—nominal in price.
DURA HOOKS
Ask your jobber—or write for DURA HOOK Bulletin No. DHPP covering sizes and prices.
The PERFECT SEAL
DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

sizes from ½ to 12-in., and for pressures up to 250 psi. The rest of the 50-page catalog contains data on valve sizing, installation and maintenance. Farris Flexible Valve Corp., Palisades Park, N.J.

Circle No. **42** *on Reply Card*

Manual

. . . of laboratory safety: *Bulletin FS 201* is a pocket-size booklet covering the hazards of plant lab work, and how to guard against them. First aid, fire fighting, safety equipment, and accident prevention are some of the topics treated. Another useful section is a short bibliography of other references on this special aspect of refinery operation. Fisher Scientific, 711 Forbes St., Pittsburgh 19, Pa.

Circle No. **43** *on Reply Card*

Gas separation

. . . at low temperatures: *L'Air Liquide* is a 36-page oversize brochure that describes the operations of this French firm that recently changed the name of its American subsidiary. The history of low temperature processes for separation of gases as pioneered by this company, and descriptions of how these gases are used in petrochemical and petroleum plants are included. American Air Liquide Inc., 405 Lexington Ave., New York 17, N.Y.

Circle No. **44** *on Reply Card*

Titanium pipe

. . . and tubing: *Technical Data Card 185* presents condensed data on B&W titanium tubular products. Sizes and tolerances, mechanical and physical properties, corrosion resistance and heat treatment of this new metal for the process industries are all included in this 12-page release. Babcock & Wilcox Co., Tubular Products Division, Beaver Falls, Pa.

Circle No. **45** *on Reply Card*

Stainless steel fittings

. . . for corrosion resistance: *Speedline Fittings* is a 21-page catalog, which describes this stainless steel piping that is extended beyond the conventional length of elbows. This extra length is to permit easier installation and better flow conditions. Horace T. Potts Co., Erie Ave. and D St., Philadelphia 34, Pa.

Circle No. **46** *on Reply Card*

Oil-from-coal

. . . at the world's largest plant in South Africa: *The Kelloggram, Issue*

Motor oils compounded with ORONITE ADDITIVES

give your customers what they want

Engine cleanliness! The modern automobile demands better motor oils and your customers are well aware of this fact. Throughout the nation, marketers of Oronite additive compounded motor oils are gaining better sales positions with superior products they market. With Oronite additives you can prove "engine cleanliness" and engine protection to your customers.

Custom-formulation to an individual oil marketer's needs is an Oronite specialty. By tailoring to your base oil and individual needs, you can provide your customers with exclusive, made-to-order motor oils. Why not talk it over with a lube oil additive specialist. Contact the Oronite office nearest you.

Custom-formulation for individual oil marketer —an Oronite specialty!

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Arnold O. Beckman INC.

OXYGEN ANALYZERS!

For time-saving, *accurate* measurements of Oxygen in your process or laboratory operations, select from the complete range of Oxygen Analyzers offered by Arnold O. Beckman, Inc.

Each instrument operates on the field-proven Arnold O. Beckman *paramagnetic* principle which makes a direct physical measurement on the Oxygen itself. No chemicals, no complicated secondary relationships are used!

MODEL D2 — Spot-checks on purged tanks, lines, or flue gas are done quickly and conveniently with the Model D2. This unit is completely self-contained, battery-operated and weighs only 3½ lbs. Operation is simple—merely squeeze a bulb to draw sample into the Analyzer, press a switch, and observe the O_2 concentration indicated on the graduated scale. Available with either 0-25% O_2 (0-190 mm) or a 0-100% O_2 (0-760 mm) dual range, the Model D2 accurately performs to ± 2% of full scale.

MODEL C — For higher accuracy with narrower ranges (than available with the D2), the Model C will meet your more advanced needs. Select almost any single range 0-5%, 0-10%, 16-21% 85-100% O_2 etc. (or equivalent in mm O_2 partial pressure). Accuracy is ± 1% of full scale. A 95% response to any reading is obtained in less than one minute. Oxygen content is read directly from a graduated scale. Measurements may be taken on either continuous or fixed volume samples. 115 Volts 50/60 cycles. Weight: 12 lbs.

RECORDING ANALYZERS — For continuous, automatic operation, Models F3 and G2 Analyzers provide millivolt, current, or pneumatic output for operation with standard recorders. Ranges from 0-0.1% O_2 to 0-100% O_2, 16-21%, etc. Multiple ranges, explosion-resistant cases, as well as complete sampling systems are available extras with the Models F3 or G2.

MODEL E2 — The precision-designed Model E2 fits the needs of installations requiring maximum accuracy. Offering a choice of single or multiple ranges, the Model E2 provides quick, easy readings when a potentiometer dial is manually adjusted to restore a light beam to its null position. Oxygen content is read directly from the dial. Minimum range 0-1% O_2 with accuracy of ± 1% of full scale. Ranges 0-5% O_2 and wider . . . accuracy ± 0.5% of full scale. 115 volts 50/60 cycles. Weight: 31 lbs.

FOR MORE INFORMATION— Outline your particular problems and let Arnold O. Beckman's experienced engineers offer recommendations for your specialized needs. Bulletins on any and all of the Arnold O. Beckman Analyzers are yours for the asking.

For General Information, Ask for Data File 211-67

Arnold O. Beckman INC.

Profit Builders for Industry

1020 MISSION STREET

SOUTH PASADENA, CALIFORNIA

What's new (continued)

No. 2, 1957 describes in detail the design, engineering and start up of the SASOL plant near Johannesburg. Some of the 19 process units are described in detail, including the power plant, oxygen plant, oil product treating and recovery, phenol extraction and the gasification and Kellogg synthesis which produces gasoline from coal. The M. W. Kellogg, 711 Third Ave., N.Y. 17, N. Y.

Circle No. **47** *on Reply Card*

Did you miss these?

The following items, reviewed originally in February, have aroused considerable interest among readers. They are repeated here briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

Plastic check valve

. . . handles corrosive gases, vapors and fluids in any flow system that can use polyvinyl chloride. It can be installed in any position.

Called the "Technocheck-PVC," the valve uses the same principle of the company's metal check valves. Body of the valve is fabricated of tubing and the flanges meet ASA standards. Internals are of PVC with sealing members of plasticized PVC, neoprene, or Buna-N—all reinforced with nylon for high strength. Metal parts are stainless steel.

The unit is available in standard sizes from 1 to 8-in. diameter, with male threaded ends from 1 to 4 in., or with standard flange or socket ends. Techno Corporation, 16 West 5th St., Erie, Pa.

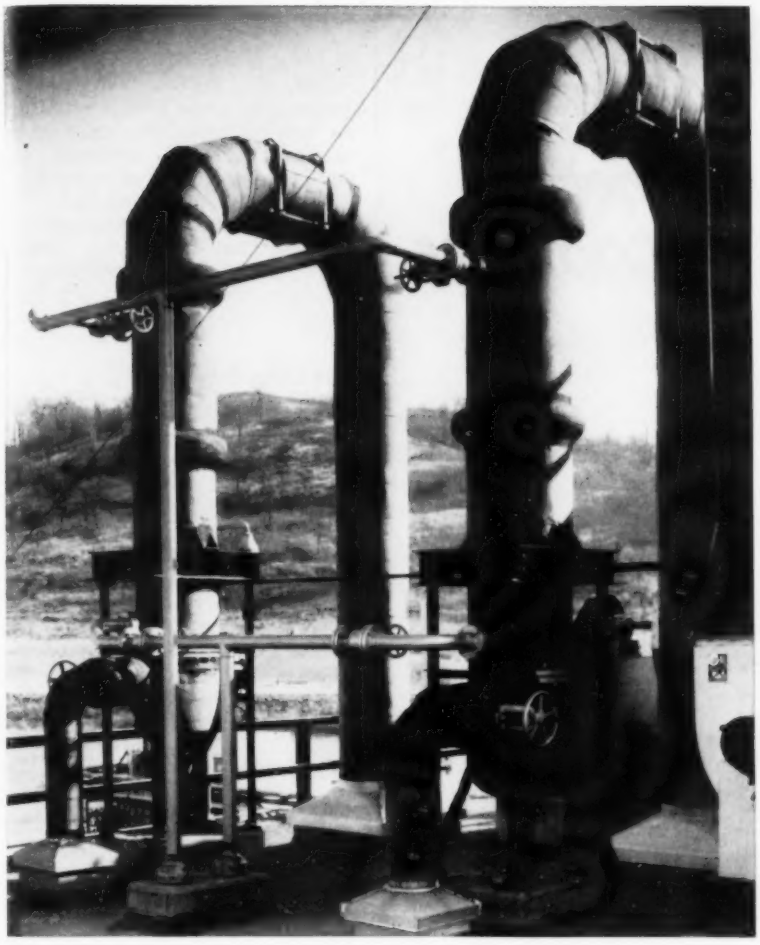
Circle No. **48** *on Reply Card*

Sonic gas analyzer

. . . accurately monitors mixtures of gases, indicating variations in the gas ratios. It exploits the wide differences in sonic velocities of gases to achieve measurable sensitivities of 0.005% oxygen in air and 0.00061% of hydrogen. Sensitivity is retained from 0 to 100 per cent of the range.

The instrument contains a long tube in which the velocity of sound is measured. Gas is fed into the tube at its center and flows out at both ends, so that the velocity of flow is cancelled. Thus, it does not increase or decrease the rate of sound transmission.

Sound waves generated at one end



ON DUTY FOR NATIONAL ANILINE...

NICKEL HEAT EXCHANGERS FROM

ALBERGER

The new Moundsville, West Virginia, plant of National Aniline Division, Allied Chemical & Dye Corp., has some of the most modern chemical processing equipment to be found anywhere in the world. Among this equipment are many Alberger Heat Exchangers, of which two are shown above as the left part of each inverted U.

The two heat exchangers are identical. Tubes, tube sheets and end sections are of nickel to handle the end product of the plant—diisocyanates. Shells with expansion joints are of carbon steel.

The final product enters the heat exchangers at the top as a gas and flows out of the exchanger as a liquid through the elbows at the left. The gas is condensed by cooling water entering and leaving the shell through the narrow silvered piping.

The axial thermal expansion of piping and heat exchangers is absorbed by nickel anti-compression expansion joints shown at the top of each inverted U. These joints were engineered and manufactured by American District Steam, which, like Alberger, is also a division of Yuba Industries, Inc.

Alberger has made 40,000 installations since its founding 53 years ago. Its engineers would be pleased to consult with you regarding heat exchangers.

ON THE WEST COAST
CALIFORNIA STEEL PRODUCTS DIVISION
Richmond, California

ADSCO DIVISION
YUBA INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

(To obtain more data on advertised products see page 158)

HOW! PUMP USERS!

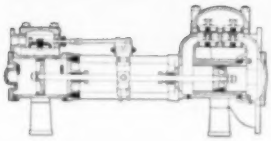
Go Modern... Go 3500 RPM

● Where *Overall Specific Speed* indicates, take advantage of the lower costs that go with modern, high speed centrifugal pumps. For any given condition, the higher the rotating speed, the smaller the pump, and the smaller the driver.

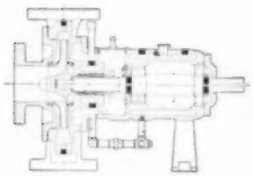
WARNING! High speeds require mechanical reliability. Dean Brothers standard centrifugal pumps are designed for 3500 RPM.

The Best is our Standard

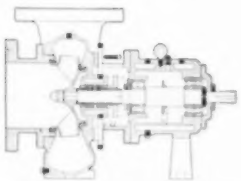
A WIDE RANGE OF OVERALL SPECIFIC SPEEDS IS COVERED BY THESE DEAN BROTHERS PUMPS



RECIPROCATING TYPE
Low Capacities and High Heads.
Indicated for Overall Specific Speeds of less than 500.



CENTRIFUGAL TYPE
Medium Capacities and Moderate Heads.
Indicated for Overall Specific Speeds from 500 to 3500.



MIXED FLOW TYPE
High Capacities and Low Heads.
Indicated for Overall Specific Speeds from 3500 to 5000.

OVERALL SPECIFIC SPEED

$$N_s = N\sqrt{Q}/H^{3/4}$$

N_s = Overall Specific Speed
N = Pump Rotative Speed
Q = Pump Capacity—gpm
H = Head—ft.

● If you would like to know how *Overall Specific Speed* can help you select the proper pump, write us or call your local Dean Brothers representative.

DEAN BROTHERS PUMPS INC.
EST. 1869
323 West 10th St., Indianapolis 7, Ind.

of the tube are received by a crystal transducer at the other. An oscillation frequency of about 150 kc/sec is used for high sensitivity. The phase of the received signal is compared with that of the generating crystal, and the phase shift is a precise measure of the change in velocity of sound propagation. National Instruments Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md.

Circle No. **49** *on Reply Card*

Technical manual

. . . on a versatile chemical intermediate: *Ethylene Oxide* is a 43-page technical bulletin presenting available information on analytical procedures, physical and chemical properties, as well as industrial applications for this material. Data is included on handling techniques, toxicity, and specifications on the various grades offered by this company. A documented bibliography lists almost 500 literature references about this petroleum-derived chemical. Jefferson Chemical Co., Inc., P.O. Box 303, Houston 1, Texas.

Circle No. **50** *on Reply Card*

Plastic pipe catalog

. . . lists three materials: PVC (polyvinyl chloride), styrene co-polymer, and Buna-N (acrylonitrile-butadiene). *Catalog P101* includes technical and descriptive data about plastic pipe, fittings and valves made from these three materials. Tables detail the physical and chemical properties of each. Also included are lists of sizes, working pressures and dimensions of all the products made. Vanton Pump & Equipment Corp., 201 Sweetland Ave., Hillside, N.J.

Circle No. **51** *on Reply Card*

Cost estimation data

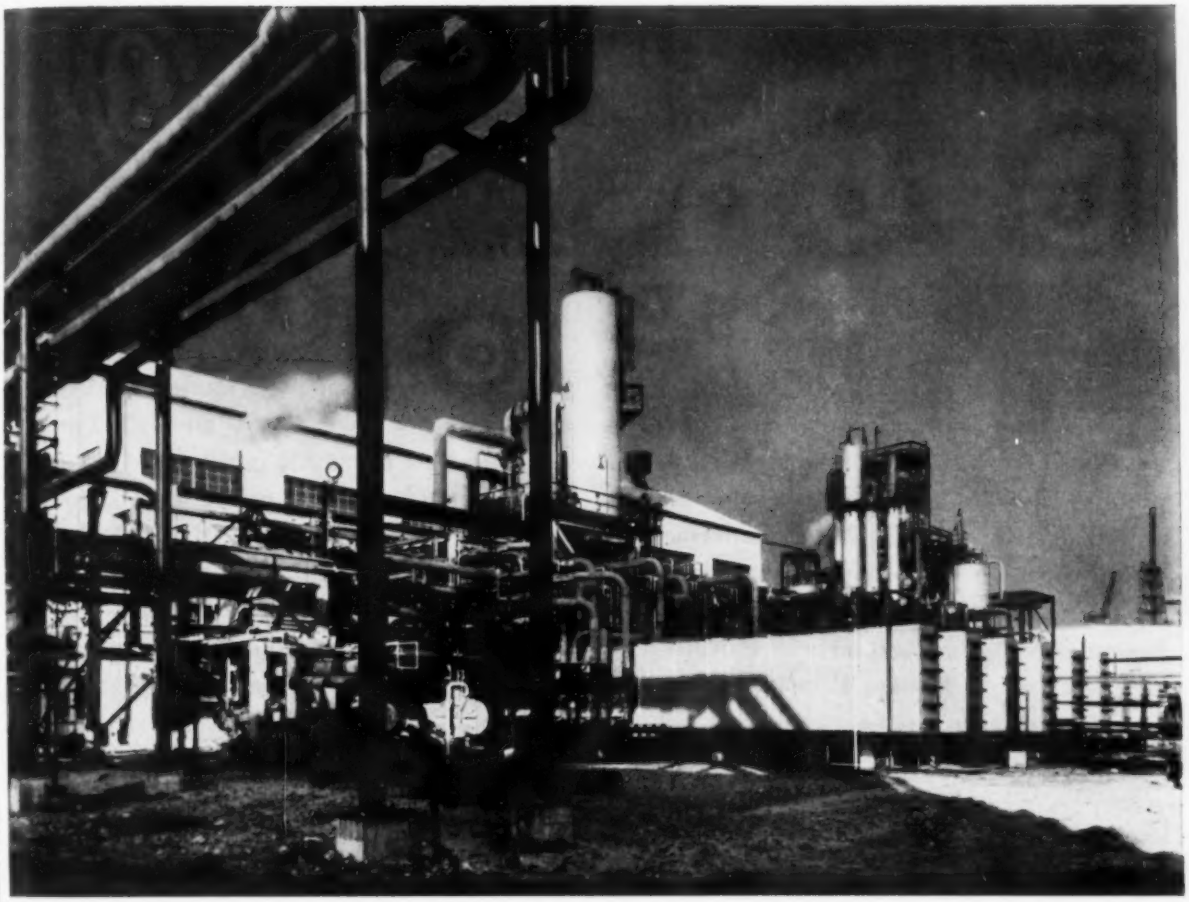
. . . for impervious graphite equipment: *Bulletin No. 249* is a 29-page report designed to help with the cost estimation and selection of this kind of equipment. Each piece of equipment is shown in a drawing, all standard models are listed, and detailed costs are supplied in $/sq ft of transfer area or some other convenient unit.

The report covers heat exchangers of many types—tube and shell, cubical, crossbore, plate and bayonet types—as well as cascade coolers, HCl absorbers, towers, centrifugal pumps, rupture discs, pipe fittings and valves. Falls Industries Inc., Aurora Road, Solon, Ohio.

Circle No. **52** *on Reply Card*

dewaxing-deoiling

...5800 bbls/day



RECENTLY completed for a large Midwestern refiner, this modern MEK Dewaxing-Deoiling plant will process in blocked operation both waxy distillates for wax removal and oily waxes for oil extraction. It is designed to produce zero and lower pour point oils and waxes meeting trade oil content specifications. Foster Wheeler supplied process and mechanical design, engineering and construction.

Foster Wheeler's long experience in this specialized field is your best assurance of complete satisfaction, from initial planning to final installation and on-stream service. Foster Wheeler process design engineers offer more than 20 years of continuous and cumulative experience in lube oil manufacture. Their intimate knowledge of all phases of design, engineering and construction — plus their close relationship with all licensor companies — can save time, effort and expense in any expansion or modernization program. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

(To obtain more data on advertised products see page 158)

What Research Means to American Business

American industry plans to invest $150 billion in new plant and equipment during the next four years—more than in the five years 1952-1956. It plans to carry out this record investment even though manufacturing capacity has nearly doubled since World War II. These facts are reported in McGraw-Hill's tenth annual survey of Business' Plans for New Plants and Equipment. They contradict many long-established theories about investment in capital goods.

According to the textbooks, a high and rising level of capital investment is generally followed by a decline. The bigger the rise—so the old theory goes—the bigger the decline will be. But, after a decade of high-level investment and an especially strong rise in the past two years, industry now has plans to keep right on with near-record outlays for plant and equipment. Does this mean some new factor has been added, to change the investment cycle?

The New Factor—Research

The latest McGraw-Hill survey points out one new factor which, more than any other, is changing the nature of the investment process. This is the record outlay planned by U.S. corporations for **scientific research and development**—to create new products and develop new industrial processes. The rapid growth of research in industry, and plans for even more remarkable growth in the years ahead, are shown by the accompanying table.

This year industry plans to spend $7 billion on research and development — up 20% from 1956. By 1960 it will spend $9 billion — enough to create a major new industry.

By 1960 manufacturing industry expects sales to be up 26% — with half the increase in products that were not made in 1956.

Growth of Research and Development Expenditures

(Millions of Dollars)

			PLANNED	
	1955	1956	1957	1960
Machinery	408	506	577	704
Electrical Equipment	950	1,149	1,310	1,637
Aircraft and Parts	1,038	1,558	2,274	3,161
Fabricated Metal Products and Ordnance	134	165	174	210
Professional and Scientific Instruments	185	252	300	453
Chemicals	440	498	528	617
Paper, Rubber, Stone, Clay and Glass Products	149	174	196	233
Petroleum Products	171	205	225	277
Other Manufacturing	1,038	1,279	1,388	1,557
Non-manufacturing industries	254	310	347	419
ALL INDUSTRIES	4,767	6,096	7,319	9,269

What Research Is Doing

Here are some examples of how industrial research is opening up new markets, or compelling the modernization of old facilities:

New automatic controls in petroleum refining will raise the quality of gasoline and reduce the time required for production. A new process for recovering oil from depleted wells promises to multiply our potential reserves.

A new process for treating iron ore will permit the ore to be fed directly into steel furnaces—without the need for blast furnaces or coke ovens.

New turbine engines—made possible by the development of heat-resistant alloys for turbine parts—offer greatly increased power for aircraft, ships and automobiles.

Altogether, industry plans to introduce more new products in 1957-1960 than in any previous four-year period. It also plans new processes on a scale that will make much of our present capacity obsolete. These new products and new processes are the secret behind continuing plans for high investment.

One-third of all manufacturing firms are building new plants this year to produce new products, and by 1960 this may account for 10% to 20% of all capital expenditures. At the same time, manufacturing companies report that over half their capital expenditures in the next four years will be for modernization of equipment and introduction of new processes. Thus the preponderant share of new investment will be based on developments growing out of research.

A New Kind of Prosperity

The keen interest of U. S. business firms in scientific research points the way to a new kind of prosperity for our economy—a prosperity based on deliberate creativeness. As long as we can create new products that will offer better value to consumers or cut costs to manufacturing firms, business will continue at a high level—not at fever pitch, perhaps, and it is to be hoped not at an inflationary pitch. But based on a steady stream of new products and processes, we can have a high level of general prosperity that defies the old laws of boom and bust.

It's Not Automatic

Of course, there is no guarantee. New products do not spring up by magic as the medieval alchemists hoped they would. They are found as the result of long and expensive effort in laboratories and pilot plants. This effort requires an increasing number of trained scientists and engineers. In 1957 alone, manufacturing companies report they will need 7% more of these highly trained people in research and development. And by 1960, they will need an additional 15% to carry out planned research programs.

The effort to maintain prosperity — as well as the national defense effort — will depend increasingly on this supply of scientific and technical personnel. But if we can supply the people, industry now has the plans for a research effort that will put an end to the spectre of idle plants and idle workers.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw
PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

Don't "pasteurize" brainpower . . .

Solving the Technical Manpower Shortage—No. 4 in a series

FOR the past three issues we have been exploring on these pages ways to relieve the shortage of technical manpower. The whole point of our discussion has been that the expedient way to solve the problem is to keep the men you now have.

Whenever you lose a man, the replacement you hire has to go through a period of indoctrination in order to become acclimated to your methods and procedures—during which he isn't very productive for you. At the same time, an experienced man has to spend part of his time breaking in the new man—and likewise isn't as productive as normal.

So far, we have talked about keeping your technical men by reducing turnover. And we have suggested that you might achieve that desirable goal first by paying your more experienced engineers and scientists at a level in keeping with their increased value to you, and second by rewarding them with recognition and in other non-monetary ways.

There's another source of technical manpower —the man you lose because he has to retire when he reaches your company's mandatory retirement age.

Why mandatory retirement?

There are a number of good arguments in favor of mandatory retirement. It's a nice convenient cut-off point, a way to ease out of the picture the fellow who really should be taking it easy. Also, it provides some assurance to the younger men moving ahead in your organization that there'll be openings up the ladder for them.

On the other hand, there are plenty of people 65 and older who not only want to continue working but are quite capable of doing so. If that is their wish and capacity, there should be some way in which they can continue to contribute their efforts to society's progress.

A recent survey of over 10,000 professors emeritus showed that a third of them wanted to do some kind of work—and were capable of it.

In the mid-west, a law school is staffed primarily with persons retired from other schools. It is rated among the best law schools in the country.

Another study showed that only 9% of the people who retire do so because they really want to. Over half, 56%, retire because of their employes' age policies, 26% because of poor health, and 9% for other reasons.

Retirement needs re-examination

As it was expressed recently by Dr. Howard A. Meyerhoff, Director of the Scientific Manpower Commission, "It seems to me that this whole problem of retirement age—easy though it is to have a fixed age at which everyone goes out the door—needs pretty careful re-examination, from the same standpoint that you would examine new candidates who are coming into your organization.

"What is the mental capacity of the people you are retiring? Do they still want to work for you? Can you get plenty of mileage out of them yet? . . .

"We are wasting and losing a great deal of our manpower because of this arbitrary and obsolete practice with regard to retirement."

We don't propose that mandatory retirement program be scrapped or tossed out the window simply to keep some of your technical men in harness.

But we do suggest that you could be losing a lot of desirable brainpower by putting it out to pasture prematurely—and when brainpower is so very scarce.

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